DOCUMENT 377-91

MG

RANGE REFERENCE ATMOSPHERE
NELLIS AIR FORCE BASE, NEVADA



AUGUST 1991

METEOROLOGY GROUP

# RANGE COMMANDERS COUNCIL

**WHITE SANDS MISSILE RANGE**
**KWAJALEIN MISSILE RANGE**
**YUMA PROVING GROUND**
**ELECTRONIC PROVING GROUND**
**DUGWAY PROVING GROUND**

**PACIFIC MISSILE TEST CENTER**
**NAVAL WEAPONS CENTER**
**ATLANTIC FLEET WEAPONS TRAINING FACILITY**
**NAVAL AIR TEST CENTER**
**NAVAL UNDERWATER SYSTEMS CENTER**

**EASTERN SPACE AND MISSILE CENTER**
**AIR FORCE DEVELOPMENT TEST CENTER**
**WESTERN SPACE AND MISSILE CENTER**
**CONSOLIDATED SPACE TEST CENTER**
**AIR FORCE FLIGHT TEST CENTER**
**AIR FORCE TACTICAL FIGHTER WEAPONS CENTER**

# REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188



| 1. AGENCY USE ONLY (Leave blank) | 2. REPORT DATE | 3. REPORT TYPE AND DATES COVERED |
|---|---|---|
| | August 1991 | |

**4. TITLE AND SUBTITLE**
Range Reference Atmosphere - Nellis Air Force Base, Nevada

**5. FUNDING NUMBERS**

**6. AUTHOR(S)**

**7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)**
Meteorology Group
Range Commanders Council
White Sands Missile Range, NM 88002

**8. PERFORMING ORGANIZATION REPORT NUMBER**
RCC Document 377-91

**9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)**
Range Commanders Council
STEWS-SA-R
White Sands Missile Range, NM 88002

**10. SPONSORING/MONITORING AGENCY REPORT NUMBER**
same as block 8

**11. SUPPLEMENTARY NOTES**
New document

**12a. DISTRIBUTION/AVAILABILITY STATEMENT**
APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

**12b. DISTRIBUTION CODE**

**13. ABSTRACT** *(Maximum 200 words)*

A "reference atmosphere" is a statistical model of the earth's atmosphere, derived from upper-air observations over a specific location. The individual RRA is the authoritative source for upper-atmosphere climatology over the launch and recovery site for which it has been prepared. The RRA's are used to plan, evaluate, and establish environmental launch constraints for aerospace vehicles launched from a particular location.

**14. SUBJECT TERMS**
Range reference atmosphere, RRA, upper-atmosphere climatology

**15. NUMBER OF PAGES**
149

**16. PRICE CODE**

| 17. SECURITY CLASSIFICATION OF REPORT | 18. SECURITY CLASSIFICATION OF THIS PAGE | 19. SECURITY CLASSIFICATION OF ABSTRACT | 20. LIMITATION OF ABSTRACT |
|---|---|---|---|
| UNCLASSIFIED | UNCLASSIFIED | UNCLASSIFIED | NONE |

## GENERAL INSTRUCTIONS FOR COMPLETING SF 298

The Report Documentation Page (RDP) is used in announcing and cataloging reports. It is important that this information be consistent with the rest of the report, particularly the cover and title page. Instructions for filling in each block of the form follow. It is important to ***stay within the lines*** to meet ***optical scanning requirements.***

**Block 1.** Agency Use Only *(Leave blank)*.

**Block 2.** Report Date. Full publication date including day, month, and year, if available (e.g. 1 Jan 88). Must cite at least the year.

**Block 3.** Type of Report and Dates Covered. State whether report is interim, final, etc. If applicable, enter inclusive report dates (e.g. 10 Jun 87 - 30 Jun 88).

**Block 4.** Title and Subtitle. A title is taken from the part of the report that provides the most meaningful and complete information. When a report is prepared in more than one volume, repeat the primary title, add volume number, and include subtitle for the specific volume. On classified documents enter the title classification in parentheses.

**Block 5.** Funding Numbers. To include contract and grant numbers; may include program element number(s), project number(s), task number(s), and work unit number(s). Use the following labels:

| | | | |
|---|---|---|---|
| C | - Contract | PR | - Project |
| G | - Grant | TA | - Task |
| PE | - Program Element | WU | - Work Unit Accession No. |

**Block 6.** Author(s). Name(s) of person(s) responsible for writing the report, performing the research, or credited with the content of the report. If editor or compiler, this should follow the name(s).

**Block 7.** Performing Organization Name(s) and Address(es). Self-explanatory.

**Block 8.** Performing Organization Report Number. Enter the unique alphanumeric report number(s) assigned by the organization performing the report.

**Block 9.** Sponsoring/Monitoring Agency Name(s) and Address(es). Self-explanatory.

**Block 10.** Sponsoring/Monitoring Agency Report Number. *(If known)*

**Block 11.** Supplementary Notes. Enter information not included elsewhere such as. Prepared in cooperation with..., Trans. of..., To be published in.... When a report is revised, include a statement whether the new report supersedes or supplements the older report.

**Block 12a.** Distribution/Availability Statement. Denotes public availability or limitations. Cite any availability to the public. Enter additional limitations or special markings in all capitals (e.g. NOFORN, REL, ITAR).

- **DOD** - See DoDD 5230.24, "Distribution Statements on Technical Documents."
- **DOE** - See authorities.
- **NASA** - See Handbook NHB 2200.2.
- **NTIS** - Leave blank.

**Block 12b.** Distribution Code.

- **DOD** - Leave blank.
- **DOE** - Enter DOE distribution categories from the Standard Distribution for Unclassified Scientific and Technical Reports.
- **NASA** - Leave blank.
- **NTIS** - Leave blank.

**Block 13.** Abstract. Include a brief *(Maximum 200 words)* factual summary of the most significant information contained in the report.

**Block 14.** Subject Terms. Keywords or phrases identifying major subjects in the report.

**Block 15.** Number of Pages. Enter the total number of pages.

**Block 16.** Price Code. Enter appropriate price code *(NTIS only)*.

**Blocks 17. - 19.** Security Classifications. Self-explanatory. Enter U.S. Security Classification in accordance with U.S. Security Regulations (i.e., UNCLASSIFIED). If form contains classified information, stamp classification on the top and bottom of the page.

**Block 20.** Limitation of Abstract. This block must be completed to assign a limitation to the abstract. Enter either UL (unlimited) or SAR (same as report). An entry in this block is necessary if the abstract is to be limited. If blank, the abstract is assumed to be unlimited.

DOCUMENT 377-91

# RANGE REFERENCE ATMOSPHERE
# NELLIS AIR FORCE BASE, NEVADA

AUGUST 1991

Prepared by

Range Reference Atmosphere Committee
Meteorology Group
Range Commanders Council

Published by

Secretariat
Range Commanders Council
White Sands Missile Range
New Mexico 88002

## PREFACE

The state of the atmosphere over national ranges and aerospace vehicle launch and recovery sites is critical not only to launch and recovery operations but to aerospace research and development as well. In the early 1960s, missile range operators recognized the need for a realistic atmospheric model that was consistently derived for each of the several major missile test ranges then in operation. Such a model, derived from climatological statistics for a given location, was developed and named a "range reference atmosphere." Even though the application has since broadened to include all aerospace launch and recovery sites, the model is still referred to as a "range reference atmosphere" or "RRA."

The first RRA (for Cape Canaveral) was prepared in 1963 by the Inter-Range Instrumentation Group (IRIG). More RRAs were produced for other ranges through 1974. Since then, improved upper-air data bases have become available not only because of an extended period of record but because of more and better rocketsonde data above 30 km. Although some improved RRAs were published in 1983 and 1984, revisions must continue, because

- aerospace technology requirements continue to change--the space shuttle program is an example;
- extended and improved upper-air data bases for most existing ranges permit development of better, more comprehensive RRAs;
- new launch and recovery sites have been opened;
- there have been significant advances in understanding the structure and physics of the upper atmosphere; and
- there have been similar advances in statistical modeling techniques, largely because of ever-larger, faster, and more sophisticated computers.

For these reasons, the Range Reference Atmosphere Committee (RRAC) was tasked by the Range Commanders Council/Meteorology Group (RCC/MG) to produce new and revised RRAs as required. The RRAC, through task MG-1, publishes RRAs for ranges specified by the RCC. An RRA, as has already been mentioned, is a model of the atmosphere over a specified geographical area that delineates an aerospace vehicle launch and recovery site. The RRAs are for use by DOD and other U.S. Government users in planning, evaluating, and establishing environmental launch/recovery constraints for a specific facility and the aerospace vehicles launched and recovered there.

The RRA tasking requires using the best available upper-atmosphere data bases (rawinsonde, rocketsonde, and any other high-altitude data source) to create and publish (in standard format) a consistently derived model of wind and thermodynamic values through a cross-section of the upper atmosphere from surface to a specified height. The individual RRA serves as the authoritative source for upper-atmosphere climatology at a given launch/recovery site.

Wind statistics, insofar as practical, are modeled to be consistent with the rigorous mathematical probability properties of the multivariate normal probability theory. Thermodynamic statistics, insofar as practical, are modeled to be consistent with the hydrostatic equation, the equation of state, and related probability principles.

In keeping with the RCC's objective of standardization modeling technique, basic text and tabulation formats are the same for all RRAs. The new RRAs published in 1991 have undergone minor format changes designed to make them conform to DOD and ANSI technical publications standards. All RRAs provide mean values of thermodynamic quantities (pressure, temperature, and density) and moisture quantities (vapor pressure, virtual temperature, and dew point temperature). These values include a statistical measure for dispersion, that is, standard deviations and skewness coefficients. The properties of the bivariate normal probability distribution function are used for statistical modeling of wind.

The first RRA to be published in this new series is for Wake Island with an altitude range from 0 to 30 km. The order of priority for subsequent publications in the RRA series is

| Range | Altitude Range Required |
|---|---|
| 1. Nellis Range Complex, NV | 0 - 30 km |
| 2. Shemya, AK | 0 - 70 km |
| 3. Thule, GR | 0 - 70 km |
| 4. Fairbanks, AK | 0 - 30 km |

All final computations in this RRA series were performed by the USAF Environmental Technical Applications Center (USAFETAC) in response to taskings from the Ballistic Missile Office (BMO), HQ Air Weather Service (AWS/SYJ), and Detachment 2, Space Division.

Majors Cheryl Souders and Walter Miller, and Captains Doug Adamson and Brian Bjornson (all of USAFETAC/DNO), rewrote the software used to provide the primary tables, updated Chapters 1 through 4, and prepared the appendixes. The USAFETAC/LDE formatted and edited the text and graphics, prepared the camera-ready copy in standard DOD technical report format, and published the document as a USAFETAC project report.

The RCC/MG Range Reference Atmosphere Committee is made up of representatives from the Air Force, Army, NASA, Navy, and NOAA. The RRA committee members were

Mr. J. Lee (KMR)
Mr. D. Godwin (KMR)
Ms. J. Bailey (YPG)
Mr. T. O. McIntire (YPG)
Mr. S. W. Bieda, Jr. (EPG)
Mr. G. Boire (WSMC)
Mr. H. C. Herring (ESMC)
Col J. T. Madura, USAF (ESMC)
Maj A. F. Dye, USAF (ESMC)
Mr. B. F. Boyd (ESMC)
Mr. C. W. Fain (ESMC)
Maj R. Hughes, USAF (AFFTC)
Lt B. Hickel, USAF (AFFTC/UTTR)
CPO G. A. Dillie, USN (NWC)
Mr. D. R. Thornley (WSMR)
Mr. E. J. Keppel (AFDTC)
Capt R. M. Fogarty, USAF (6585th TG)
Lt Col T. F. Tascione, USAF (AFDTC)
Mr. J. Kerwin (AFDTC)
Lt Col R. J. Ericson, USAF (CSTC)
Capt W. Gibbons, USAF (TFWC)
Mr. L. S. Corbett (NWC)
Mr. J. J. Genola (NWC)
Mr. D. Tolzin (PMTC)
Lt R. Kren, USN (NATC)
Mr. J. Trischman (NATC)
Lt Col J. E. Erickson, (USAFETAC)
Mr. R. Olsen (WSMR), Chairman

# TABLE OF CONTENTS

## TABLE OF CONTENTS (CONT'D)

## LIST OF TABLES



## LIST OF FIGURES

# Chapter 1

# INTRODUCTION TO THE RANGE REFERENCE ATMOSPHERE (RRA)

## 1.1 THE RRA DEFINED

A "reference atmosphere" is a statistical model of the earth's atmosphere, derived from upper-air observations over a specific location. The atmospheric models developed by the Range Reference Atmosphere Committee (RRAC) in response to a tasking by the Range Commanders Council/Meteorology Group (RCC/MG) and published by the Secretariat, Range Commanders Council are called "Range Reference Atmospheres" or "RRAs." The first series of RRAs was published from 1963 to 1974, and a second series was issued in 1983 and 1984.

## 1.2 PURPOSE OF THE RRA

The individual RRA is the authoritative source for upper-atmosphere climatology over the launch and recovery site for which it has been prepared. The RRAs are used to plan, evaluate, and establish environmental launch constraints for aerospace vehicles launched from a particular location.

## 1.3 CONTENTS OF THE RRA

The RRAs contain tabulations for monthly and annual means, standard deviations, and skewness coefficients for wind speed, pressure, temperature, density, water vapor pressure, virtual temperature, and dew point temperature. They also provide means and standard deviations for zonal and meridional wind components and the linear (product moment) correlation coefficient between wind components. Statistical values are tabulated (at the station elevation) at 1-km intervals from mean sea level (MSL) to 30 km and at 2-km intervals from 30 to 70 km. Wind statistics begin at about 10 meters above station elevation and continue at altitudes with respect to MSL thereafter. For ranges without rocketsonde measurements, RRAs terminate at 30 km; they may be extended upward, if necessary, when rocketsonde data from a nearby location can be made available.

## 1.4 UNITS OF MEASUREMENT USED IN RRAs.

All wind speeds are in meters per second (m/s). In all cases, the skewness coefficient and the correlation coefficient between wind components are unitless. Pressure (including water vapor pressure) is in millibars (mb). Temperature and virtual temperature are in kelvin (K). Density is in grams per cubic meter ($gm/m^3$). All altitudes are geometric in kilometers (km). All heights are geopotential also in kilometers (km). All altitudes/heights are in relation to mean sea level.

## 1.5 RRA QUALITY CONTROL

Less than 10 percent of the soundings in the data base used to calculate the RRA tables contained erroneous data. Soundings that did contain erroneous data values were eliminated from the data base. Steps taken to produce an RRA that is as error-free as possible are described below.

(1) Soundings with gaps in their pressure levels of more than 200 mb were rejected. These soundings were eliminated because some contained height values only for mandatory pressure levels; when some heights at the mandatory levels were missing, the interpolated sounding contained significant errors.

(2) An initial set of RRA statistics was computed using all the remaining soundings (that is, those that had not been rejected). This set was then used to determine data limits for temperature, pressure, U and V components of wind, density, and dew point for the 0-30 km portion and density only from 30 to 60 km (in RRAs that go that high). The lower (or upper) data limits were set at the mean value for each variable, minus (or plus) six standard deviations of that quantity. One pair of data limits was computed for each of the atmospheric variables, the month, and the data level.

(3) The first set of data limits was then used to screen the data base. All soundings that contained values outside the data limits were rejected. A new RRA was then computed using the screened data base, and the second RRA was used to generate a second set of data limits.

(4) The second set of data limits was then used to screen the data base further, and still another RRA was generated. The skewness values in this one were evaluated according to empirical criteria specified in paragraph 2.2 of this document (for winds) and in paragraph 3.2 (for thermodynamic quantities). If these criteria were satisfied, the third RRA was used to generate a final set of data limits, which were used to quality control the data base for the final version of the RRA.

(5) Occasionally, the third RRA did not satisfy all the skewness criteria, indicating that the data base still contained some erroneous values. To complete quality control, the "limits-to-RRA-to-limits" cycle was repeated (usually once or twice) until the resulting RRA satisfied the skewness criteria. When it did, a final set of data limits was generated, then used to quality control the data base and produce the final RRA.

## 1.6 HOW THE RRA IS ORGANIZED

The RRA documents are published in four chapters with Chapter 1 providing the introduction. Chapter 2, Wind Statistics and Models, describes the techniques used to produce the wind statistics given in tables A-1 through A-13 in appendix A and the probability functions used as wind models to derive several wind statistics. Chapter 3,

Statistics of Thermodynamic Quantities and Models, describes the techniques used to produce the thermodynamic and moisture-related statistics in tables B-1 through B-13 and C-1 through C-13, appendixes B and C. In addition, it describes the atmospheric thermodynamic model in tables D-1 through D-13, appendix D. Chapter 3 also contains equations used to calculate several atmospheric properties. Chapter 4 provides conclusions and recommendations. Chapters 1 through 4 are the same in each new RRA; only appendixes A-G (described next) vary from RRA to RRA.

**Appendix A** contains monthly and annual wind statistics tables that give (1) means and standard deviations of zonal and meridional wind components; (2) the linear (product moment) correlation coefficient between the two components; (3) the mean, standard deviation, and skewness coefficient of the wind speed; and (4) the number of wind observations (sample size).

**Appendix B** contains monthly and annual thermodynamic statistics tables that give (1) means, standard deviations, and skewness values of pressure, temperature, and density; and (2) the number of observations used for each of the thermodynamic quantities.

**Appendix C** contains monthly and annual moisture-related statistics tables that give (1) means, standard deviations, and skewness values of water vapor pressure, virtual temperature, and dew point; and (2) the number of observations for each of the moisture-related quantities. Statistical values for water vapor pressure and dew point terminate at or below 15 km, depending on the range's latitude. Above 15 km, statistical values of virtual temperature are considered to be the same as those of temperature.

**Appendix D** contains monthly and annual tables that give hydrostatic model atmospheres for thermodynamic variables of pressure, virtual temperature, and density. Values are derived from the monthly and annual mean virtual temperature versus altitude (geometric) using the hydrostatic equation and the equation of state. Also presented is the geopotential height corresponding to the tabulated geometric altitudes.

**Appendix E** gives range-specific examples of certain wind statistics that can be derived from the basic data in appendix A.

**Appendix F** gives tabular and graphic examples of certain pressure, density, and virtual temperature statistics that can be derived from basic data in appendixes B, C, and D.

**Appendix G** gives range-specific information such as location and data base description.

## 1.7 CONVERSION UNITS

Numerical values in the RRA are metric, as given in the International System of Units (SI, Systeme International d'Unites). Table 1-1 provides metric, U.S. Customary, and conversion units for all units used in this RRA.

**TABLE 1-1. CONVERSION UNITS USED IN RRAs.**

| DATA TYPE | METRIC UNIT | ABBR | US CUSTOMARY UNIT | ABBR | CONVERSION: Multiply | By | To Get |
|---|---|---|---|---|---|---|---|
| ***Ambient Temperature*** | degree Celsius | $^{o}C$ | degree Fahrenheit | $^{o}F$ | $^{o}F-32$ | 0.5556 | $^{o}C$ |
| | kelvin | K | degree Rankine | $^{o}R$ | $^{o}C$ | 1.8* | $^{o}F-32$ |
| | | | | | $^{o}R$ | 1.00* | $^{o}F+459.67$ |
| | | | | | $^{o}R-459.67$ | 1.00* | $^{o}F$ |
| | | | | | K | 1.00* | $^{o}C+273.15$ |
| | | | | | K-273.15 | 1.00* | $^{o}C$ |
| ***Temperature Change*** | degree Celsius | $^{o}C$ | degree Fahrenheit | $^{o}F$ | $^{o}C$ or K | 1.8* | chg $^{o}F/^{o}R$ |
| | kelvin | K | degree Rankine | $^{o}R$ | K or $^{o}R$ | 0.5556 | Chg $^{o}C/K$ |
| ***Ambient Density*** | gram/cubic meter | $gm^{-3}$ | grain/cubic foot | $grft^{-3}$ | $gm^{-3}$ | 0.43700 | $grft^{-3}$ |
| ***Vapor Concentration*** | gram/cubic centimeter | $gcm^{-3}$ | | | $grft^{-3}$ | 2.2883 | $gm^{-3}$ |
| *(Absolute humidity)* | | | | | $gm^{-3}$ | $10^{-6}$* | $gcm^{-3}$ |
| | | | | | $gcm^{-3}$ | $4.370/10^{-5}$ | $grft^{-3}$ |
| | | | | | $grft^{-3}$ | $2.288/10^{-6}$ | $gcm^{-3}$ |
| ***Windspeed*** | meters/second | $ms^{-1}$ | mile/hour | mph | $ms^{-1}$ | 2.2369 | mph |
| | | | knots | knots | mph | 0.44704* | $ms^{-1}$ |
| | | | feet/second | $fts^{-1}$ | $ms^{-1}$ | 1.9438 | knots |
| | | | | | knots | 0.51444 | $ms^{-1}$ |
| | | | | | mph | 0.868976 | knots |
| | | | | | knots | 1.15078 | mph |
| | | | | | $ms^{-1}$ | 3.2808 | $ms^{-1}$ |
| | | | | | $fts^{-1}$ | 0.3048* | $ms^{-1}$ |
| ***Weight*** | gram | g | grain | gr | lb | 0.45359237* | kg |
| | kilogram | kg | pound | lb | lb | 453.59237* | g |
| | | | | | kg | 2.20462 | lb |
| | | | | | g | 15.4324 | gr |
| | | | | | gr | 0.06480 | g |

**TABLE 1-1. CONVERSION UNITS USED IN RRAS, Cont'd.**

| DATA TYPE | METRIC UNIT | ABBR | US CUSTOMARY UNIT | ABBR | CONVERSION: Multiply | By | To Get |
|---|---|---|---|---|---|---|---|
| ***Length*** | meter | m | feet | ft | m | 3.2808 | ft |
| | micron | μ | inch | in | ft | 0.3048* | m |
| | Angstrom unit | A | | | in | $2.54\backslash10^{+4}$* | μ |
| | | | | | in | $2.54\backslash10^{+8}$* | A |
| | | | | | m | $10^{+6}$* | μ |
| | | | | | m | $10^{+10}$* | A |
| | | | | | μ | $10^{-6}$* | m |
| | | | | | μ | $3.937\backslash10^{-5}$ | in |
| | | | | | A | $10^{10}$* | m |
| | | | | | A | $3.937\backslash10^{-9}$ | m |
| ***Pressure*** | newton/square meter | newton $m^{-2}$ | pound force/sq in | lb $in^{-2}$ | mb | $10^{-3}$* | bar |
| | | | | | bar | $10^{3}$* | mb |
| | millimeter of Mercury | mmHg | inch of Mercury | mHg | newton $m^{-2}$ | $10^{-2}$* | mb |
| | | | | | newton $m^{-2}$ | $1.4504\backslash10^{-4}$ | lb $m^{-2}$ |
| | | | | | lb $in^{-2}$ | $6.8948\backslash10^{3}$ | newton $m^{-2}$ |
| | bar | bar | | | mb | $1.4504\backslash10^{-2}$ | lb $m^{-2}$ |
| | millibar | mb | | | lbin$^{-2}$ | 68.948 | mb |
| | dyne/square centimeter (microbar) | dyne $cm^{-2}$ | | | mb | $10^{3}$* | dyne $cm^{-2}$ |
| | | | | | dyne $cm^{-2}$ | $10^{-3}$* | mb |
| | kilogram force/square meter | kg $m^{-2}$ | | | lb $in^{-2}$ | $6.8948\backslash10^{4}$ | dyne $cm^{-2}$ |
| | | | | | dyne $cm^{2}$ | $1.4504\backslash10^{-5}$ | lb $m^{-2}$ |
| | | | | | mb | 10.1972 | kg $m^{2}$ |
| | | | | | l ; $m^{-2}$ | 0.0980665 | mb |
| | | | | | lb $m^{-2}$ | 703.0696 | kg $m^{2}$ |
| | | | | | kg $m^{-2}$ | 0.0014223 | lb $m^{2}$ |
| | | | | | mb | $2.9530\backslash10^{-2}$ | mHg(32°F) |
| | | | | | mb | 0.75006 | mmHg(0°C) |
| | | | | | mHg | 25.40 | mmHg(0°C) |
| | | | | | mmHg | 1.3332 | mb |
| | | | | | mHg(321) | 33.8639 | mb |
| | pascal | | | | Pa | 1.00* | newton $m^{-2}$ |

# CHAPTER 2

# WIND STATISTICS AND MODELS

## 2.1 GENERAL DISCUSSION

One of the objectives in developing an RRA is to describe the wind field over the launch/recovery site as completely as possible with as few data tabulations as possible. With that in mind, the bivariate normal probability distribution was adopted as a statistical model for wind treated as a vector quantity at RRA data levels. Only five statistical parameters are required to completely describe this probability function; in Cartesian coordinates, these parameters are the means and standard deviations of the two orthogonal components, along with the correlation coefficient between the two components. The tables in appendix A give the five statistical parameters for the zonal and meridional (meteorological coordinate) components. The statistical properties of the bivariate normal probability distribution are used to derive many wind statistics of interest to range users. The procedure produces consistent wind statistics that are connected through rigorous mathematical probability functions. By using these functions, extensive tabulations of wind statistics are avoided. Statistical properties of the bivariate normal probability distribution presented for the vector wind statistical mode are

- wind components are univariate normally distributed;
- conditional distribution of one component, given a value of the other component, is univariate normally distributed;
- wind speed is in the form of a generalized Rayleigh distribution;
- frequency distribution of wind direction can be derived;
- conditional distribution of wind speed, given a value of wind direction (wind rose), can be derived; and
- the five tabulated wind statistical parameters, with respect to the meteorological zonal and meridional coordinate system, can be derived for any arbitrary rotation of the orthogonal axes.

The RRA provides probability distribution functions and sets of equations to derive wind statistics for the previously stated properties of the vector wind model. Examples are given in appendix E.

No attempt is made here to give the derivation of the probability functions, but the reader is referred to Smith (1976) for derivations and several applications of the probability distribution properties for wind statistics.

Symbols used in chapter 2 and their meanings are given in table 2-1.

**TABLE 2-1 Symbols Used in Chapter 2.**

| | |
|---|---|
| $N$ | The number of wind measurements in Appendix A. |
| $r$ | A general variable for the bivariate normal probability distribution in polar coordinates. |
| $R$ | A generalized Rayleigh variable used for derived wind speed probability distribution. |
| $R(U,V)$ | The linear (product moment) correlation coefficient between the zonal and meridional wind components in Appendix A. |
| $SK(W)$ | Skewness parameter for wind speed in Appendix A. |
| $S(U)$ | The standard deviation of the zonal wind component in Appendix A. |
| $S(V)$ | The standard deviation of the meridional wind component in Appendix A. |
| $S(W)$ | The standard deviation of wind speed in Appendix A. |
| $t$ | A standardized normal variate used in Table 2-1. |
| $U$ | The zonal wind component. |
| $UBAR$ | The mean value of the zonal wind component in Appendix A. |
| $V$ | The meridional wind component. |
| $VBAR$ | The mean value of the meridional wind component in Appendix A. |
| $W$ | Wind speed or modulus of wind vector, a scalar quantity. |
| $WBAR$ | The mean value of wind speed in Appendix A. |
| $X$ | A general component mean value in the $[X,Y]$ coordinate system. |
| $Y$ | A general component mean value in the $[X,Y]$ coordinate system. |
| $\mathrm{X}$ | A general component variable or coordinate axes. |
| $\mathrm{Y}$ | A general component variable or coordinate axes. |
| $\alpha$ | (alpha) Rotation angle for the $[X,Y]$ coordinate system. |
| $\theta$ | (theta) Wind direction in the polar coordinate system. |
| $\lambda$ | (Lambda) A parameter in the bivariate normal probability distribution in Table 2-2. |
| $\xi$ | (Xi) The mean value in the standardized normal probability distribution used in Table 2-1. |
| $\pi$ | (Pi) Constant = 3.14159 . |
| $\rho$ | (Rho) The general linear correlation coefficient between the two component variables in the $[x,y]$ coordinate system. |
| $\sigma_x, \sigma_x$ | The general standard deviations of the $x$ and $y$ component variables in the $[x,y]$ coordinate system. |

## 2.2 QUALITY CONTROL

The U and V components of wind were used to generate data limits, which were set at plus and minus six standard deviations from the mean for each of the quantities. These data limits were used to screen the wind data base, as described in paragraph 1.5. The data base was considered to be error-free if

- the skewness of the wind speed was below 4.0 at data levels where the mean wind speed was less than 15 m/s, and
- the skewness of the wind speed was below 2.5 at data levels where the mean wind speed was greater than 15 m/s.

## 2.3 DATA LIMITATIONS

For wind statistics, correlation coefficients for like and unlike wind components between altitude levels were not computed, and wind statistics with respect to altitude (profile) cannot be derived from RRA statistics. Users are referred to Smith (1976) for wind profile modeling techniques. Wind statistics as discrete altitudes are valid; all the probability distribution functions described in chapter 2 can be derived from the five wind component statistical parameters in appendix A, and the derived distributions can be considered as wind models at discrete altitudes.

Greek letters are used conventionally for population or theoretically known statistical elements, and sample estimates are denoted by English letters or with a "circumflex" ($\wedge$) over Greek letters. In Chapter 2, Greek letters are used for variances and linear correlation coefficient, while means are denoted by $\bar{X}$ and $\bar{Y}$ when dealing with the bivariate normal distribution. It must always be understood that appendix A contains sample estimates of statistical parameters and that they are with respect to the meteorological zonal (U) and meridional (V) coordinate systems.

## 2.4 THE COORDINATE SYSTEM OF STATISTICAL PARAMETERS

Wind is measured and recorded in terms of magnitude and direction. Wind direction is expressed in degrees clockwise from true north and is the direction from which the wind is blowing. Wind magnitude (the modulus of the vector) is the scalar quantity and is referred to as wind speed or scalar wind. A statistical description that accounts for the wind as a vector quantity is appropriate and requires a coordinate system.

For the RRA, the Standard Meteorological Coordinate System has been chosen for wind statistics, all tables of statistical parameters, and related discussions. This choice was made because the coordinate system used in aerospace and related applied fields has not always been consistent. Figure 2-1 illustrates the Standard Meteorological Coordinate System.

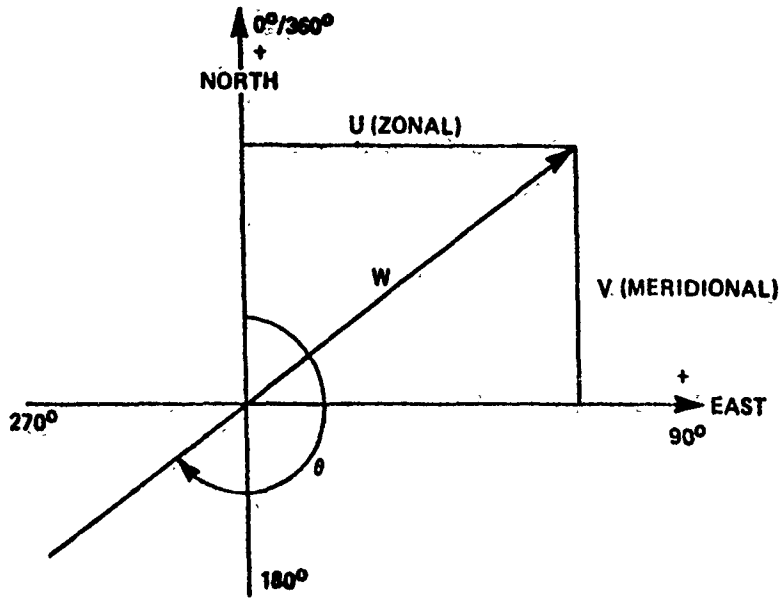


**Figure 2-1. The Standard Meteorological Coordinate System.**

Using Figure 2-1, the polar and Cartesian forms for the meteorological coordinate system are defined as

W wind speed, scalar wind, or magnitude of the wind vector (m/s);

θ wind direction, measured as the direction from which the wind is blowing, in degrees clockwise from true north;

U zonal wind component, positive west to east (m/s); and

V meridional wind component, positive south to north (m/s).

The components θ and W define the polar form, and the U-V components define the Cartesian forms:

$$U = -W \sin\theta, \; 0 \leq \theta \leq 360^\circ \tag{1}$$

$$V = -W \cos\theta \tag{2}$$

It is helpful to note the difference between the mathematical convention for vector direction and the meteorological convention for wind direction:

$$\theta_{met} = 270 - \theta_{math} \tag{3}$$

when $0 \leq \theta \leq 270^\circ$

$$\theta_{met} = 360 + (270 - \theta_{math})$$

when $270 \leq \theta \leq 360^\circ$

## 2.5 COMPUTING STATISTICAL PARAMETERS

All these statistical parameters are with respect to the Standard Meteorological Coordinate System shown in figure 2-1. The wind statistical parameters in appendix A (means and standard deviations of zonal and meridional wind components, plus wind speed and the skewness parameter of wind speed) were computed using the sums technique described in subparagraph 3.5.1. In addition, a linear (product moment) correlation coefficient between the zonal and meridional wind components, r(u,v) in appendix A, was computed. This correlation coefficient is defined as

$$r(u,v) = \frac{\sum_{i=1}^{n} (U_i - \bar{U})(V_i - \bar{V})}{N\, s(u) \cdot s(v)} \tag{4}$$

## 2.6 STATISTICAL WIND MODELS

**2.6.1 Wind Component Statistics.** The univariate normal (Gaussian) probability distribution function is used to obtain wind component statistics. In generalized notations, the probability density function (pdf) is

$$F(T) = \frac{e^{-\frac{t^2}{2}}}{\sqrt{2\pi}} \tag{5}$$

where $t = X - \frac{\xi}{\sigma_x}$ is the standardized variate, with $\xi$ defining the mean and $\sigma$ the standard deviation.

The probability distribution function (PDF) is

$$F(t) = \int_{-\infty}^{t} f(t)\, dt \tag{6}$$

Because this integral cannot be obtained in closed form, it is widely tabulated for zero mean and unit standard deviation. Selected values of F(t) are given in table 2-2. To emphasize the connotation of probability, F(t) is shown in table 2-2 as P{X}. The t values in table 2-2 are used as multiplier factors to the standard deviation to express the probability that a normally distributed variable (X) is less than or equal to a given value as

$$P\{X \leq mean + t\,\sigma_x\} = probability, p \tag{7}$$

For example, when t = 1.6449, the probability that X is less than or equal to the mean plus 1.6449 standard deviations is 0.95. That value of X which is less than or equal to the mean plus 1.6449 standard deviations is called the "95th percentile value of X." Also given in table 2-2 are the numerical values for expressing the probability that X falls in the interval $X_1$ and $X_2$; that is,

$$P\{X_1 \leq X \leq X_2\} = \text{Interpercentile Range} \tag{8}$$

where

$$X_1 = \bar{X} - t\,\sigma_x$$
$$X_2 = \bar{X} + t\,\sigma_x$$

For t = 1.9602 the probability that X lies in the interval $X_1$ and $X_2$ is 0.95. The values of $X_1$ and $X_2$ in this example comprise the 95th interpercentile range.

For a normally distributed variable, the mode (most frequent value) and the median (50th percentile value) are the same as the mean value. The means and standard deviations of the zonal and meridional wind components from appendix A are used in equations 7 and 8 to compute the percentile values and interpercentile ranges of the zonal and meridional wind components. When equation 7 is illustrated on a normal graph, a straight line is formed.

**2.6.2 The Vector Wind Model.** Because wind is a vector quantity having direction and magnitude that can be expressed as two components in an orthogonal coordinate system, a probability model that describes the joint relationship is the bivariate normal probability distribution. In general component notation (shown in equation 9), the bivariate normal probability density function (BNpdf) is

$$f(X,Y) = \frac{1}{2\pi\sigma_x\sigma_y\sqrt{1-\rho^2}}\left[exp\ \frac{-1}{2(1-\rho^2)}\left\{\frac{(X-\bar{X})^2}{\sigma_x^2} - \frac{2\rho(X-\bar{X})\,(Y-\bar{Y})}{\sigma_x\sigma_y} + \frac{(Y-\bar{Y})^2}{\rho_y^2}\right\}\right] \quad -\infty \leq X \leq \infty\ \&\ -\infty \leq Y \leq \infty) \qquad (9)$$

where the five parameters are $\bar{x}, \bar{y}$, the component means $\sigma_X$, $\sigma_Y$, the component standard deviations, and $\rho$, the correlation coefficient between the two component variables X and Y.

For many applications there is interest in determining the probability that a point X,Y will fall within a contour of equal probability density. The exponential terms of equation 9, when set equal to a constant ($\lambda_2$), give a family of ellipses depending on the value of the constant. The ellipses have a common center at the point $\{\bar{X}, \bar{Y}\}$. Integration of equation 9 over the region bounded by the contours of equal probability density gives

$$P(\lambda) = 1 - e^{\frac{-\lambda^2}{2(1-\rho^2)}} \qquad (10)$$

Solving for $\lambda^2$ and replacing $P(\lambda)$ by p gives

$$\lambda^2 = -2(1-\rho^2)\ ln(1-p) \qquad (11)$$

Now define

$$\lambda_e = \sqrt{2}\ \sqrt{-ln(1-p)} \qquad (12)$$

TABLE 2-2. Values of t for Standardized Normal (Univariate) Distribution for Percentiles and Interpercentile Ranges.

| t | P(X) | X | $P\{X_1 \leq X \leq X_2\}$ (%) |
|---|---|---|---|
| -3.0000 | 0.00135 | $\xi - 3.0000\,\sigma$ | 99.73 (0.27) |
| -2.5758 | 0.00500 | $\xi - 2.5758\,\sigma$ | 99 (1.00) |
| -2.3263 | 0.01000 | $\xi - 2.3263\,\sigma$ | 98 (2.00) |
| -2.2365 | 0.01266 | $\xi - 2.2365\,\sigma$ | 97.468 (2.532) |
| -2.0000 | 0.02275 | $\xi - 2.0000\,\sigma$ | 95.45 (4.55) |
| -1.9602 | 0.02500 | $\xi - 1.9602\,\sigma$ | 95 (5) |
| -1.6449 | 0.05000 | $\xi - 1.6449\,\sigma$ | 90 (10) |
| -1.2816 | 0.10000 | $\xi - 1.2816\,\sigma$ | 80 (20) |
| -1.0000 | 0.15866 | $\xi - 1.0000\,\sigma$ | 68.268 (31.732) |
| -0.8416 | 0.20000 | $\xi - 0.8416\,\sigma$ | 60 (40) |
| -0.6745 | 0.25000 | $\xi - 0.6745\,\sigma$ | 50 (50) |
| -0.2533 | 0.40000 | $\xi - 0.2533\,\sigma$ | 20 (80) |
| 0.0000 | 0.50000 | $\xi$ | |
| 0.2533 | 0.60000 | $\xi + 0.2533\,\sigma$ | |
| 0.6745 | 0.75000 | $\xi + 0.6745\,\sigma$ | |
| 0.8416 | 0.80000 | $\xi + 0.8614\,\sigma$ | |
| 1.0000 | 0.84134 | $\xi + 1.0000\,\sigma$ | |
| 1.2816 | 0.90000 | $\xi + 1.2816\,\sigma$ | |
| 1.6449 | 0.95000 | $\xi + 1.6449\,\sigma$ | |
| 1.9602 | 0.97502 | $\xi + 1.9602\,\sigma$ | |
| 2.0000 | 0.97725 | $\xi + 2.0000\,\sigma$ | |
| 2.2365 | 0.98734 | $\xi + 2.2365\,\sigma$ | |
| 2.3263 | 0.99000 | $\xi + 2.3263\,\sigma$ | |
| 2.5758 | 0.99500 | $\xi + 2.5758\,\sigma$ | |
| 3.0000 | 0.99865 | $\xi + 3.0000\,\sigma$ | |

where $X_1 = \xi - t\sigma$
and $X_2 = \xi + t\sigma$

For reference and comparison, $\lambda_e$ is shown in table 2-3 for selected values of p.

**TABLE 2-3. Values of $\lambda$ for Bivariate Normal Distribution Ellipses and Circles.**

| P(%) | ($\lambda_e$--ellipse) | ($\lambda_c$--circle) | P(%) | ($\lambda_e$--ellipse) | ($\lambda_c$--circle) |
|---|---|---|---|---|---|
| 0.000 | 0.0000 | 0.0000 | 65.000 | 1.4490 | 1.0246 |
| 5.000 | 0.3203 | 0.2265 | 68.268 | 1.5151 | 1.0713 |
| 10.000 | 0.4590 | 0.3246 | 70.000 | 1.5518 | 1.0973 |
| 15.000 | 0.5701 | 0.4031 | 75.000 | 1.6651 | 1.1774 |
| 20.000 | 0.6680 | 0.4723 | 80.000 | 1.7941 | 1.2686 |
| 25.000 | 0.7585 | 0.5363 | 85.000 | 1.9479 | 1.3774 |
| 30.000 | 0.8446 | 0.5972 | 86.466 | 2.0000 | 1.4142 |
| 35.000 | 0.9282 | 0.6563 | 90.000 | 2.1460 | 1.5175 |
| 39.347 | 1.0000 | 0.7071 | 95.000 | 2.4477 | 1.7308 |
| 40.000 | 1.0108 | 0.7147 | 95.450 | 2.4860 | 1.7579 |
| 45.000 | 1.0935 | 0.7732 | 98.000 | 2.7971 | 1.9778 |
| 50.000 | 1.1774 | 0.8325 | 98.168 | 2.8284 | 2.0000 |
| 54.406 | 1.2533 | 0.8862 | 98.889 | 3.0000 | 2.1213 |
| 55.000 | 1.2637 | 0.8936 | 99.000 | 3.0348 | 2.1460 |
| 60.000 | 1.3537 | 0.9572 | 99.730 | 3.4393 | 2.4320 |
| 63.212 | 1.4142 | 1.0000 | 99.9877 | 4.2426 | 3.0000 |

The probability ellipse that contains p-percent of the wind vectors expressed in the most general form is the conic defined by

$$AX^2 + BXY + CY^2 + DX + EY + F = 0 \tag{13}$$

Where

$$A = \sigma_y^2 \qquad D = 2\sigma_x\sigma_y\,\rho\bar{Y} - 2\sigma_y^2\bar{X} = -(B\bar{Y} + 2A\bar{X})$$

$$B = -2\rho\sigma_x\sigma_y \qquad E = 2\sigma_x\sigma_y\,\rho\bar{X} - 2\sigma_x^2\bar{Y} = -(B\bar{X} + 2C\bar{Y})$$

$$C = \sigma_x^2 \qquad F = A\bar{X}^2 + C\bar{Y}^2 + B\bar{X}\bar{Y} - AC\,(1-\rho^2)\,\lambda_e^2$$

and

$$\lambda_e = \sqrt{2}\,\sqrt{-\ln(1-\rho)}$$

For graphic presentations, the range of the variable is important in order to arrange the scale. The largest and smallest values of X and Y for a given probability ellipse (p) are given by

$$X_{L,S} = \bar{X} \pm \sigma_x\lambda_e \tag{14}$$

$$Y_{L,S} = \bar{Y} \pm \sigma_y\lambda_e \tag{15}$$

where, as before,

$$\lambda_e = \sqrt{2}\,\sqrt{-\ln(1-\rho)}$$

Although there are several approaches to graphing the probability ellipses, the following procedure is best for electronic computer plotting. In establishing the computer plotting program, the sample estimates for $\bar{X}$, $\bar{Y}$, $\sigma_x'$, $\sigma_y'$, and $\rho$ are constants in equation 13. The user makes the choice of probability ellipses desired. Thus, p in equation 12 is programmed as a parameter. The largest and smallest values for X and Y are computed by equations 14 and 15 for the largest probability ellipses selected, which sets the graphical scale. Values of X within the range of X smallest to X largest are obtained by incrementing X between these limits. Using the quadratic equation, a solution of equation 13 is made for Y for each value of X, and plotted. The centroid $(\bar{X},\bar{Y})$ for the family of probability ellipses is plotted as a point. Labeling and other identification completes the plotting program.

For a given probability, equation 13 defines an ellipse that contains p-percent of the points X,Y. Since the entire area under the bivariate normal density function (equation 9) is unity, upon integration for a given probability ellipse, that given ellipse contains p-percent of the total area. In the wind statistics, p-percent of the wind vectors fall within the specified probability ellipse. From this point of view, a specified probability ellipse gives the joint probability that p-percent of the U-V components lie within the given ellipse.

When $\sigma_x^2 = \sigma_y^2 = \sigma^2$ and $\rho = 0$ in the bivariate normal distribution, the probability ellipses of equation 13 reduce to circles whose centers are at the means $\bar{X},\bar{Y}$. The radii of the probability circles are $\sigma_{V1}\lambda_c'$, where

$$\sigma_{V1} = \sqrt{2\sigma^2} \tag{16}$$

$$\lambda_c = \sqrt{-1n\,(1-p)} \tag{17}$$

Values for $\lambda_c$ for selected probabilities, p, are given in table 2-3.

Because this function is simple, it can easily be graphed manually. However, the generalized plotting technique for electronic computer plotters (as shown by equation 13) can also be used.

**2.6.3 Derived Distributions for Wind Statistics.** In this section, the probability distribution functions and sets of equations are presented to derive certain probability distribution functions for wind statistics. These derived probability distributions are

- conditional distribution of wind components,
- generalized Rayleigh distribution for wind speed,
- distribution for wind direction, and
- conditional distribution of wind speed given a wind direction (wind rose).

The five required statistical parameters for these derived distributions for wind statistics are given in appendix A.

**2.6.3.1 The Conditional Distribution of Wind Components.** Given that two random variables X and Y are bivariate normally distributed, the conditional distribution f(Y|X) is read as f(Y) given X, and likewise f(X|Y) is read as f(X) given Y. The conditional probability function F(Y|X) has the mean (E(Y|X) and variance $\sigma^2_{(x|y)}$, where

$$E(Y|X^*) = \bar{Y} + \rho\left(\frac{\sigma_y}{\sigma_x}\right)(X^* - \bar{X}) \tag{18}$$

and

$$\sigma^2_{(y|x^*)} = \sigma_y^2\,(1-\rho^2) \tag{19}$$

The conditional standard deviation is

$$\sigma_{(y|x^*)} = \sigma_y\sqrt{1-\rho^2} \tag{20}$$

By interchanging the variables and parameters, the conditional distribution function for F(X|Y*) has the conditional mean

$$E(X|Y^*) = \bar{X} + \rho\left(\frac{\sigma_x}{\sigma_y}\right)(Y^* - \bar{Y}) \tag{21}$$

conditional variance

$$\sigma^2_{(x|y^*)} = \sigma_x^2\,(1-\rho^2) \tag{22}$$

and conditional standard deviation

$$\sigma_{(x|y^*)} = \sigma_x\sqrt{1-\rho^2} \tag{23}$$

The preceding conditional probability distribution functions are univariate normal distributions for a (fixed) given value for one of the bivariate normal variables. Thus, the t-values given in table 2 are applicable for conditional probabilities statements. For example,

$$F(Y|X^*) = E(Y|X^*) + t\sigma_{(y|x^*)} \tag{24}$$

For t = 1.6449, there is a 95 percent chance that Y is less than or equal to $\bar{Y}$ + 1.6449 $\sigma_{(y|X^*)}$ given that X = $X^*$. In symbols, this statement reads

$$P\{Y \le E(Y|X^*) + 1.6449\,\sigma_{(y|x^*)}|X = X^*\} = 0.9500 \tag{25}$$

Interval probability statements can also be made

$$P\{Y_1 = E(Y|X^*) - t\sigma_{(y|x^*)} \le Y \le Y_2 = E(Y|X^*) + t\sigma_y\ |X = X^*\}$$

where $X^*$ can take on any fixed value of X, but a convenient arrangement is to let $X^*$ = $\bar{X} \pm t\sigma_X$.

The close connection of the regression function of Y on X to the conditional mean for the bivariate normal distribution is noted as

$$Y = \bar{Y} + \rho\left(\frac{\sigma_y}{\sigma_x}\right)(X - \bar{X}) \tag{26}$$

Similarly, the regression function of X on Y is

$$X = \bar{X} + \rho\left(\frac{\sigma_x}{\sigma_y}\right)(Y - \bar{Y}) \tag{27}$$

These are linear functions and express the same results as would be obtained from a least-squares regression line.

**2.6.3.2 Generalized Rayleigh Distribution for Wind Speed.** If two random variables, X and Y, are bivariate normally distributed, then the probability distribution for the modulus, R, can be derived in terms of the five parameters that define the bivariate normal distribution:

$$R = \sqrt{X^2 + Y^2} \tag{28}$$

The distribution of R, so derived, is called a generalized Rayleigh distribution, because there are no restrictions on the parameters. For applications to the RRA, the variable R is recognized as wind speed or the modulus of the wind vector.

The probability density function for R is expressed as

$$f(R) = a_0 R e^{-a_1 R^2}\left[I_0(a_2 R^2)\, I_0(a_3 R) + 2\sum_{k=1}^{\infty} I_k(a_2 R^2)\, I_{2k}(a_2 R)\cos 2k\psi\right] \quad R \geq 0 \tag{29}$$

The functions $I_0(\cdot)$, $I_k(\cdot)$, and $I_{2k}(\cdot)$ are the modified Bessel function of the first kind for zero order, kth order, and 2kth order. The coefficients are

$$a_0 = \frac{exp\left[-\frac{1}{2}\left\{\frac{\bar{X}^2}{\sigma_a^2} + \frac{\bar{Y}^2}{\sigma_b^2}\right\}\right]}{\sigma_a \sigma_b}$$

where $\sigma_a^2$ and $\sigma_b^2$ are the rotated variances to produce zero correlation between X and Y. $\sigma_a$ and $\sigma_b$ are the positive and negative roots of the following expression, the computational form of which is obtained from the determinant

$$\begin{vmatrix} \sigma_x^{2-K} & \sigma_x\sigma_y\sigma \\ \sigma_x\sigma_y\sigma & \sigma_y^2 - K \end{vmatrix}$$

where K is $\sigma^2_{(+,-)}$, and $\sigma_a$ and $\sigma_b$ are analogous to the standard deviation of the major and minor axes of the bivariate normal probability ellipse

$$\sigma^2_{(+,-)} = \frac{1}{2}\left\{\sigma_x^2 + \sigma_y^2 \pm \left[(\sigma_x^2 + \sigma_y^2)^2 - 4\sigma_x^2\sigma_y^2(1-\rho^2)\right]^{\frac{1}{2}}\right\}$$

$$a_1 = \frac{(\sigma_x^2 + \sigma_y^2)}{4(1-\rho^2)\sigma_x^2\sigma_y^2}$$

$$a_2 = \frac{\left[(\sigma_x^2 - \sigma_y^2)^2 + 4\rho^2\sigma_x^2\sigma_y^2\right]^{\frac{1}{2}}}{4(1-\rho^2)\sigma_x^2\sigma_y 2}$$

$$a_3 = \left[\left(\frac{\bar{X}}{\sigma_a^2}\right)^2 + \left(\frac{\bar{Y}}{\sigma_b^2}\right)^2\right]^{\frac{1}{2}}$$

and

$$\tan\Psi = \frac{\bar{Y}}{\bar{X}}\frac{\sigma_a^2}{\sigma_b^2}$$

Since this density function cannot be integrated in closed form from zero to R, numerical integration is used to obtain practical results from the probability distribution function; that is,

$$F(R) = \int_0^{R*} f(R)\,dR \qquad (30)$$

A number of special cases can be obtained from the general Rayleigh distribution (equation 29), the most simple of which is to let $\sigma_x = \sigma_y = \sigma$ and $\bar{X} = \bar{Y} = 0$ with independent variables X and Y, which gives

$$f(R) = \frac{R}{\sigma^2} e^{\frac{-R}{2\sigma^2}} \qquad (31)$$

which is recognized as the classical Rayleigh probability density function. The density function (equation 31) can be integrated in closed form over any range of the variable R. Hence, the probability distribution function, F(R), for equation 31 is

$$F(R) = 1 - exp\left\{\frac{-R^2}{2\sigma^2}\right\} \qquad (32)$$

**2.6.3.3 The Derived Distribution of Wind Direction.** Considering the wind as a vector quantity and bivariate normally distributed, the wind direction can be derived. This is done by first writing the bivariate normal probability density function in polar coordinates whose variables are

$$g(r,\theta) = r d_1 e^{\frac{1}{2}(a^2r^2 - 2br + c^2)} \qquad (33)$$

**NOTE**

**The expression in equation 33 (Smith, 1976) is given with respect to the mathematical convention for a vector direction where**

$$a^2 = \frac{1}{(1-\rho^2)}\left[\frac{\sin^2\theta}{\sigma_x^2} - \frac{2\rho\cos\theta\sin\theta}{\sigma_x\sigma_y} + \frac{\cos^2\theta}{\sigma_y^2}\right]$$

$$b = \frac{-1}{(1-\rho^2)}\left[\frac{\bar{x}\sin\theta}{\sigma_x^2} - \frac{\rho(\bar{x}\cos\theta + \bar{y}\sin\theta)}{\sigma_x\sigma_y} + \frac{\bar{y}\cos\theta}{\sigma_y^2}\right]$$

$$c^2 = \frac{1}{(1-\rho^2)}\left[\frac{\bar{x}^2}{\sigma_x^2} - \frac{2\rho xy}{\sigma_x\sigma_y} + \frac{\bar{y}^2}{\sigma_y^2}\right]$$

$$d_1 = \frac{1}{2\pi\sigma_x\sigma_y\sqrt{1-\rho^2}}$$

and $r = \sqrt{x^2+y^2}$ is the modulus of the vector or speed and $\theta$ is the direction of the vector. After integrating $g(r,\theta)$ over $r=0$ to $\infty$, the probability density function $\theta$ is

$$g(\theta) = \frac{d_1}{a^2}\, e^{-\frac{1}{2}c^2}\left[1 + \sqrt{2\pi}\left(\frac{b}{a}\right)^2 \Phi\left(\frac{b}{a}\right)\right] \qquad (34)$$

where $a^2$, $b$, $c^2$, and $d_1$ are as previously defined in equation 33, and

$$\Phi\left(\frac{b}{a}\right) \quad \Phi(x) = \frac{1}{\sqrt{2\pi}} \int_{-\infty}^{x} e^{-\frac{1}{2}t^2}\, dt$$

is taken from tables of normal distribution functions or made available through a computer subroutine.

If desired, equation 34 can be integrated numerically over a chosen range of $\theta$ to obtain the probability that the vector direction will lie within the chosen range; that is,

$$F(\theta) = \int_{\theta_2}^{\theta_1} g(\theta)\, d\theta \qquad (35)$$

One application may be to obtain the probability that the wind will flow from a given quadrant or sector as onshore, for example.

**2.6.3.4 Derived Conditional Distribution of Wind Speed Given Wind Direction.** Continuing with the considerations expressed in subparagraph 2.6.3.3, the conditional probability density function (pdf) for wind speed (r), given a specified value for the wind direction θ, can be expressed as

$$f(r\,|\,\theta) = \frac{a^2\, r\, e^{-\frac{1}{2}(a^2 r^2 - br)}}{1 + \sqrt{2\pi}\left(\frac{b}{a}\right) e^{\frac{1}{2}\left(\frac{b}{a}\right)^2} \Phi\left\{\frac{b}{a}\right\}} \tag{36}$$

where coefficients, a and b and the function $\Phi\left\{\frac{b}{a}\right\}$ are as previously defined in equations 33 and 34.

From equation 36, the mode (most frequent value) of the conditional wind speed given as specified value of the wind direction is the positive solution of the quadratic equation,

$$a^2 r^2 - br - 1 = 0 \tag{37}$$

which is

$$(\tilde{r}\,|\,\theta) = \frac{1}{2a}\left[\left(\frac{b}{a}\right) + \sqrt{4 + \left(\frac{b}{a}\right)^2}\right] \tag{38}$$

The locus of the conditional modal values of wind speed when plotted in polar form versus the given wind directions forms an ellipse.

The noncentral moment for equation 36 is expressed as

$$\mu_n' = \int_0^\infty r^n\, f(r\,|\,\theta)\, dr \tag{39}$$

Now the first noncentral moment is identical to the first central moment or expected value, E(r|θ). The integration of equation 39 for the first moment is sufficiently simple to yield practical computations, and can be expressed as

$$E(r\,|\,\theta) = \frac{\left(\frac{b}{a}\right) + \left[1 + \left(\frac{b}{a}\right)^2\right] \sqrt{2\pi}\, e^{\frac{1}{2}\left(\frac{b}{a}\right)^2} \Phi\left\{\frac{b}{a}\right\}}{a\left[1 + \left(\frac{b}{a}\right) \sqrt{2\pi}\, e^{\frac{1}{2}\left(\frac{b}{a}\right)^2} \Phi\left\{\frac{b}{a}\right\}\right]} \tag{40}$$

Equation 40, then, gives the conditional mean value of the wind speed given a specified value for the wind direction.

The integration of equation 36 for the limits r = 0 to r = $r^*$ gives the probability that the conditional wind speed is $\leq r^*$ given a value for the wind direction, $\theta$. This conditional probability distribution (PDF) can be written as

$$Pr\{r \leq r^* | \theta = \theta_0\} = 1 - \left[ \frac{e^{-\frac{1}{2} r_s^2 + \sqrt{2\pi}\left(\frac{b}{a}\right)\{1 - \Phi(r_s)\}}}{e^{-\frac{1}{2}\left(\frac{b}{a}\right)^2 + \sqrt{2\pi}\left(\frac{b}{a}\right) \cdot \left\{\frac{b}{a}\right\}}} \right] \tag{41}$$

where

$$r_s = \left[ a r^* - \left(\frac{b}{a}\right) \right]$$

By definition, equation 41 is an expression for a "wind rose." Empirical wind rose statistics are often tabulated or graphically illustrated given the frequency that the wind speed is not exceeded for those wind speed values which lie within assigned class intervals of wind direction. After evaluation of equation 41 for various values of wind speed, $r^*$, and the given wind directions, $\theta$, interpolations can be performed to obtain various percentile values of the conditional wind speed.

For the special case when b in equation 33 equals zero (that is, for $\bar{x} = \bar{y} = 0$), the conditional modal values of wind speeds (equation 38), the conditional mean values of wind speeds (equation 40), and the fixed conditional percentile values of wind speeds (interpolated from evaluations of equation 41), when plotted in polar form versus the given wind directions, produce a family of ellipses.

For the special case when $\bar{x} = \bar{y} = 0$, equation 36 reduces to the following simple case:

$$Pr\{r \leq r^* | \theta = \theta_0\} = 1 - e^{-\frac{a^2 r^{*2}}{2}} \tag{42}$$

Equation 42 has special significance when related to the bivariate normal probability distribution. If $r^*$ and $\theta$ are measured from the centroid of the probability ellipse, then the probability that $r \leq r^*$ is the same as the given probability ellipse. Further, solving equation 42 for $r^*$, gives

$$r^* = \frac{1}{2}\sqrt{-2 \ln (1 - P)} \tag{43}$$

If a probability ellipse P is chosen, equation 42 gives the distance of r along any $\theta$ from the centroid of the ellipse to the intercept of the specified probability ellipse. If there is an interest in conditional probability of winds for a given $\theta$ relative to the monthly means, equation 43 is applicable. If it is desired to find the magnitude of the wind along any $\theta$ relative to the monthly mean to the intercept of a given probability ellipse, equation 43 is also applicable.

## 2.7 STATISTICAL PARAMETERS FOR NON-STANDARD ORTHOGONAL AXES

The five wind statistical parameters in appendix A are given with respect to the Standard Meteorological Coordinate System (figure 2-1). That is, these parameters are for zonal and meridional components. Many range users, however, need wind statistics with respect to orthogonal axes other than west to east and south to north. For example, a user may need wind statistics with respect to a flight azimuth of $\alpha$ degrees from true north measured clockwise. The following sets of equations are used to compute the five parameters for the new coordinate axes rotated $\alpha$ degrees clockwise from true north.

Rotation of the means through $\alpha$ degrees

$$\bar{X}_\alpha = \bar{X}\cos(90-\alpha) + \bar{Y}\sin(90-\alpha) \tag{44}$$

$$\bar{Y}_\alpha = \bar{Y}\cos(90-\alpha) - \bar{X}\sin(90-\alpha) \tag{45}$$

Rotation of the variances through $\alpha$ degrees

$$\sigma_{x_\alpha}^2 = \sigma_x^2\cos^2(90-\alpha) + \sigma_y^2(90-\alpha) + 2\rho\sigma_x\sigma_y\cos(90-\alpha)\sin(90-\alpha) \tag{46}$$

$$\sigma_{y_\alpha}^2 = \sigma_y^2\cos^2(90-\alpha) + \sigma_x^2\sin^2(90-\alpha) - 2\rho\sigma_x\sigma_y\cos(90-\alpha)\sin(90-\alpha) \tag{47}$$

Rotation of the linear correlation coefficient through $\alpha$ degrees

$$\rho_\alpha = \frac{cov(X,Y)_\alpha}{\alpha_{x_\alpha}\alpha_{y_\alpha}} \tag{48}$$

where cov $(X,Y)\alpha$ is the rotated covariance:

$$cov(X,Y)_\alpha = (X,Y)\left[\cos^2(90-\alpha) - \sin^2(90-\alpha)\right] + \cos(90-\alpha)\sin(90-\alpha)\left(\sigma_y^2 - \sigma_x^2\right)$$

and

$$cov(X,Y) = \rho\sigma_x\sigma_y$$

By using these rotational equations, the bivariate normal distribution with respect to any desired rotated coordinates can be obtained from sample estimates that have been computed with respect to a specific axis. The marginal distributions after rotation are also normally (univariate) distributed. By using the rotational equations, computational efforts are greatly reduced to applications requiring statistics with respect to several coordinate axes. Appendix E gives examples of range-specific RRA wind statistics.

# CHAPTER 3

# THERMODYNAMICS STATISTICS AND MODELS

## 3.1 GENERAL DISCUSSION

One of the objectives in developing the RRA was to describe the thermodynamic characteristics of the atmosphere as completely as possible with as few data tabulations as possible. With that in mind, a set of statistical variables was selected to collectively describe climatological pressure, temperature, density, dew point, virtual temperature, and water vapor pressure. Used together, these variables permit calculation of a large number of derived quantities. Some of these quantities such as the speed of sound are discussed in paragraph 3.7.

The probability distribution of each of the six thermodynamic RRA variables is described by its mean value, its standard deviation, and its skewness. Several of the thermodynamic elements (temperature, pressure, dew point, and density) have probability distributions that are close to a univariate normal distribution; the others do not. The skewness variable gives an estimate of asymmetrical departures of a probability distribution.

Hydrostatically modeled mean values of pressure and density were calculated (see appendix D) so that users can determine the departure of the actual climatology of these values from hydrostatic conditions. This was done by hydrostatically integrating the pressure from the lowest RRA data level to the RRA's termination altitude. Table 3-1 lists and explains the primary physical constants used in RRA production. Table 3-2 lists and explains the symbols used in this chapter.

**TABLE 3-1. Primary Physical Constants Used in RRA Production.**

| | |
|---|---|
| $P_0$ | Standard atmospheric pressure at sea level ($1.013250 \times 10^5$ Newton/m$^2$) ($2116.22$ lb/ft$^2$) |
| $\rho_o$ | Standard atmospheric density at sea level ($1.2250$ kg/m$^3$) ($0.076474$ lb/ft$^3$) |
| $T_0$ | Standard temperature at sea level ($288.15$ K) ($15.0^0$C) ($59.0^0$F) |
| $g_0$ | Standard gravity at sea level at latitude $45^0 31' 33''$ ($9.80665$ m/s$^2$) |
| $s$ | Sutherland's constant used in calculation of dynamic viscosity ($110.4$ K) |
| $T_l$ | Ice-point temperature at $P_o$ ($273.15$ K) |
| $\beta$ | Constant for calculating dynamic viscosity ($1.458 \times 10^{-6}$ kg/sec m K$^{\frac{1}{2}}$) ($7.3025 \times 10^{-7}$ lb/sec ft R$^{\frac{1}{2}}$) |
| $\gamma$ | Ratio of specific heat of air at constant pressure to specific heat of air at constant volume ($1.4$) |
| $C_D$ | Mean effective collision diameter of air molecules ($3.65 \times 10^{-10}$ m) ($1.1975 \times 10^{-9}$ ft) |
| $N_a$ | Avogadro's constant ($6.022169 \times 10^{26}$/kg mol) ($2.73179 \times 10^{26}$/lb mol) |
| $R^*$ | Gas constant ($8.31432$ Joule/mol K) |
| $R'$ | Gas constant for dry air ($2.8704 \times 10^2$ Joule/kg K) |
| $M$ | Molecular weight of dry air ($28.966$ gm/mol) |

TABLE 3-2. Symbols Used In Chapter 3.

| | |
|---|---|
| $C_s$ | Speed of sound |
| $C_d$ | Collision diameter |
| $E$ | Vapor pressure |
| $g_\phi$ | Gravity at latitude $\phi$ |
| $H$ | Geopotential height |
| $H_m$ | Geopotential height at a mandatory radiosonde data level |
| $H_s$ | Geopotential height at a significant radiosonde data level |
| $K_t$ | Coefficient of thermal conductivity |
| $L$ | Mean free path length |
| $M$ | Mean molecular weight of air at sea level |
| $M3q$ | Monthly third-moment of quantity $Q$ |
| $n$ | Refractive modulus |
| $N$ | Refractive index |
| $NA$ | Avogadro's constant |
| $Nq$ | Number of values of quantity $Q$ |
| $P$ | Pressure |
| $P_m$ | Pressure at a mandatory radiosonde data level |
| $P_s$ | Pressure at a significant radiosonde data level |
| $P_h$ | Hydrostatically integrated mean monthly or annual pressure |
| $Q$ | Any tabulated RRA quantity |
| $R^*$ | Universal gas constant |
| $R$ | Specific gas constant of dry air |
| $r$, $r^*$ | Parameters used in converting $z$ to $h$ and vice versa |
| $S$ | Sutherland's constant, used in the calculation of dynamic viscosity |
| $T$ | Temperature |
| $T_d$ | Dewpoint |
| $T_v$ | Virtual temperature |
| $T_{vm}$ | Virtual temperature at a mandatory radiosonde data level |
| $T_{vs}$ | Virtual temperature at a significant radiosonde data level |
| $V$ | Mean air particle speed |
| $V_c$ | Mean collision frequency |
| $w$ | Parameter used in the hydrostatic interpolation of pressure and density |
| $Z$ | Geometric altitude |
| $X$ | Wavelength |
| $^{\alpha}Q$ | Skewness of quantity $Q$ |
| $B$ | Constant used in the equation for viscosity |
| $\gamma$ | Ratio of specific heat at constant pressure to specific heat at constant volume |
| $\eta$ | Kinematic coefficient of viscosity |
| $\mu$ | Dynamic coefficient of viscosity |
| $\rho$ | Density |
| $\rho h$ | Mean monthly or annual density derived from $Ph$ |
| $\sigma$ | Standard deviation of the quantity $Q$ |

## 3.2 QUALITY CONTROL

Data limits derived from the following thermodynamic elements were used to screen the RRA data base: temperature, pressure, dewpoint (for the 0-30 km portion only), and density. These limits were set to plus and minus six standard deviations from the mean values of each of these quantities; they were used to screen the thermodynamic portion of the data base in accordance with procedures described in paragraph 1.5. The data base was considered to be error-free if

(1) skewness values of pressure and temperature were between -2.5 and 2.5 at all data levels,

(2) skewness values of density were between -3.5 and 3.5 at data levels between 0 and 30 km,

(3) skewness values of density were between -3.0 and 3.0 at data levels between 30 and 70 km, and

(4) skewness values of dewpoint were between -2.5 and 2.5 at all data levels with more than 10 data values.

## 3.3 DATA LIMITATIONS

Correlation coefficients between thermodynamic quantities and moisture-related quantities were not calculated at discrete altitudes, neither were any of the correlations between altitudes. As a result, valid statistical dispersion models that require a relationship between two or more of these quantities at the same altitude or between altitudes cannot be derived. Approximations for the correlation coefficients between pressure, virtual temperature, and density at discrete altitudes, however, may be obtained from the coefficients of variation as developed by Buell (1970). The coefficient of variation is the standard deviation divided by the mean. The mean values and the standard deviations are taken from appendix B. A model for the profile of monthly and annual mean pressure, virtual temperature, and density is given in appendix D and is in agreement with the respective statistical mean values. This agreement results because the physical relationships expressed by the hydrostatic equation and the equation of state were used to derive appendix D. When only the monthly or annual mean values for pressure, virtual temperature, and density are required, users should consult appendix D.

## 3.4 ESTABLISHING DATA SAMPLES AT REQUIRED LEVELS

This section describes the computational procedures used to establish data samples of the thermodynamic RRA variables at the various data levels. References are cited only when the equation given is one of many available in the literature or when it is stated in an unusual form.

**3.4.1 Converting Geopotential Height to Geometric Altitude.** Although rocketsonde observations above 30 km are recorded in terms of geometric altitude, the data can be interpolated directly to the altitude intervals shown in the tables. But radiosonde observations used to obtain tabular values below 30 km are recorded in terms of geopotential height; the conversion to geometric altitude (h to z) is accomplished by calculating a table of geopotential heights that correspond exactly to the geometric altitudes at which the atmospheric elements are tabulated. Radiosonde observations are then interpolated to these geopotential heights. The relationship used to calculate geometric altitude from geopotential height is

$$H = (r' z)/(r^* + z) \tag{49}$$

where $r' = g r^*/9.80665$

and $r^* = -2g_\phi / (\partial g_\phi / \partial z_o)$

$g_\phi$ is sea level at latitude $\phi$ corresponding to the proper location (List, 1968).

$$g_\phi = 9.780356\,(1 + 5.2885 \times 10^{-3}\, sin^2\,\phi - 5.9 \times 10^{-6}\, sin^2\,(2\phi)) \tag{50}$$

$\frac{\partial g_\phi}{\partial z_o}$ is the rate of change of gravity at sea level. This quantity is given by

$$\frac{\partial g_\phi}{\partial z_o} = -3.085462 \times 10^{-6} \times 2.27 \times 10^{-9}\, cos\,(2\phi) \times 2 \times 10^{-12}\, cos\,(4\phi) \tag{51}$$

Units used for gravity are $m/s^2$, while the units for $\frac{\partial g_\phi}{\partial z_o}$ are $s^{-2}$.

The resulting table of values of H obtained by using even increments of 2 in equation 49 is shown in appendix D. Although the values of H above 30 km were not used in the interpolation of original data, they are included for the convenience of the user.

**3.4.2 Calculations from Rawinsonde Observations.** It was necessary to interpolate information from original rawinsonde records to arrive at the geometric altitudes specified as RRA data levels. Elements for which this interpolation was required were temperature, dewpoint, and pressure. The other elements were calculated from the interpolated values at each RRA data level. These "derived" elements were water vapor pressure, density, and virtual temperature.

**3.4.2.1 Geopotential Height at Significant Levels.** Two slightly different interpolation procedures were used to obtain data from radiosonde and rocketsonde observations at the levels shown in the tables. The procedure used to interpolate radiosonde observations begins with calculations of virtual temperature at each data level in the sounding. Virtual temperature was computed by

$$T_v = T/(1. - 0.379\,(e/p)) \tag{52}$$

where $T_v$ and $T$ are in kelvin (K) and e and p are in millibars.

Radiosonde soundings provide pressure, temperature, and dew point data recorded at "mandatory" and "significant" levels. Geopotential height data, however, is only provided for mandatory levels. Heights at the significant levels, therefore, were calculated hydrostatically, using pressure and temperature data from those levels. This procedure allows the use of most significant level data in the calculation of the RRA tables. The equation used for this process was

$$H_s = Hm + 29.2712617 * \frac{(T_w + T_{vm})}{2} * \ln (P_s/P_m) \qquad (53)$$

where subscripts s and m denote quantities at significant and mandatory levels. This equation was not used if the difference between two adjacent mandatory levels was greater than 200 mb, and all soundings with such data gaps were rejected.

**3.4.2.2 Temperature.** Radiosonde temperatures were interpolated logarithmically with respect to pressure using the equation

$$T = T_U + (T_L - T_U) \frac{\ln p - \ln p_L}{\ln p_U - \ln p_L} \qquad (54)$$

where subscripts U and L indicate values at the nearest data levels in the actual sounding above and below the interpolated level.

**3.4.2.3 Pressure.** The pressure values in each radiosonde sounding were interpolated to the RRA data levels using the equation

$$p = pL \exp\left(\frac{H_L - H_U}{29.2712617\,(0.5)\,(T_{v_U} + T_{v_L})}\right) \qquad (55)$$

where subscript L indicates virtual temperature, geopotential, and pressure values at the data level below and closest to the level at which data were required.

**3.4.2.4 Dew Point Temperature.** Dew point values were interpolated logarithmically with respect to pressure using the equation

$$T_d = T_{dU} + (T_{dL} - T_{dU}) \left(\frac{\ln p - \ln p_L}{\ln p_U - \ln p_L}\right) \qquad (56)$$

Subscripts U and L indicate data at the nearest upper and lower data levels in a sounding.

**3.4.2.5 Vapor Pressure.** Water vapor pressure is calculated from interpolated dew point values at RRA data levels using Teten's approximation

$$e = 6.11\ mb \times 10^{7.5(T_d - 273.15)/(T_d - 35.86)} \tag{57}$$

**3.4.2.6 Density.** Density values derived from radiosonde observations were calculated at RRA data levels using the equation

$$\rho = 348.36787\ p/T_v \tag{58}$$

**3.4.2.7 Virtual Temperature.** Virtual temperature values are calculated at RRA data levels for each sounding using the equation

$$T_v = T/(1 - 0.379(e/p)) \tag{59}$$

where $T_V$ and T are in K; pressure (p) and vapor pressure (e) are in millibars.

**3.4.3 Calculations from Rocketsonde Observations.** Rocketsonde observations used to calculate RRA table values above 30 km were recorded in terms of geometric altitude. For this reason, slightly different calculations were required to convert recorded data values to RRA data levels. Pressure, temperature, and density were interpolated to RRA data levels. Since atmospheric moisture at altitudes above 30 km is considered to be negligible, moisture-related elements (virtual temperature, water vapor pressure, and dewpoint) were not calculated. There was no interpolation across gaps in pressure or temperature data in a sounding larger than 7,000 meters. Data values at RRA levels within such a gap were set to "missing."

**3.4.3.1 Temperature.** Rocketsonde temperatures were interpolated linearly with respect to geometric altitude using the equation

$$T = T_U + (T_L - T_U)\,\frac{Z - Z_L}{Z_U - Z_L} \tag{60}$$

where subscript U indicates values at the nearest data level in the actual sounding above the interpolated level; L indicates values below the interpolated level.

**3.4.3.2 Pressure.** Rocketsonde pressure values were interpolated to RRA data levels using the equation

$$P = P_L\ exp\left(-\frac{g_\phi}{R^*}\,\frac{M\,(Z - Z_L)}{T_v} \cdot W^2\right) \tag{61}$$

where

$$T_v = \frac{Tv_U + Tv_L}{2} \text{ and } W = \frac{r^*}{\left(r^* + Z + \frac{Z - Z_L}{2}\right)}$$

**3.4.3.3 Density.** Rocketsonde density values were interpolated using the equation

$$\rho = \rho_L \exp\left(-\frac{g_\phi M}{R^*}\frac{(Z - Z_L)}{T_v} \cdot W^2\right) \tag{62}$$

where W is specified in subparagraph 3.4.3.2.

## 3.5 COMPUTING STATISTICS FOR APPENDIXES B AND C

Computing monthly and annual means, standard deviations, and skewness values from data at the RRA data levels was performed in two steps. First, certain statistical sums were calculated and stored as the soundings in the data base were processed. These sums were then used to calculate the monthly and annual statistics given in the RRA tables.

**3.5.1 Stored Statistical Sums.** The sums calculated were

$$\Sigma Q, \Sigma Q^2, \text{and } \Sigma Q^3$$

where $Q$ is any one of the quantities given in the thermodynamic part of the RRA.

**3.5.2 Calculating Monthly Statistics.** Equations 63 and 64 are used to calculate monthly standard deviations and skewness values.

**3.5.2.1 Monthly Means.** Mean monthly values of the thermodynamic RRA quantities were calculated using the equation

$$\overline{Q} = \Sigma Q / N_Q$$

where $N_Q$ is the number of observed values of the quantity $Q$ for a given month.

**3.5.2.2 Monthly Standard Deviations.** Monthly standard deviations of the thermodynamic RRA quantities were calculated using the equation

$$\sigma_Q = \sqrt{\frac{(N_Q \Sigma Q^2) - (\Sigma Q)^2}{N_Q \cdot (N_Q - 1)}} \tag{63}$$

**3.5.2.3 Monthly Skewness Values.** Monthly skewness values of wind speed and thermodynamic RRA quantities are calculated using the equation

$$\sigma_Q = \frac{M3_Q}{\sigma_Q^3}$$

where $M_{3Q}$ is the third moment of the quantity Q, $\sigma_Q$ is its standard deviation, and

$$M_{3Q} = \left[\frac{\Sigma Q^3}{N_Q} - \frac{3\Sigma Q \Sigma Q^2}{N^2_Q} + \frac{2\Sigma Q^3}{N^3_Q}\right] \cdot \frac{N_Q^2}{(N_Q - 1)(N_Q - 2)} \qquad (64)$$

**3.5.3 Calculating Annual Statistics.** Equations 63 and 64, used to calculate monthly standard deviations and skewness values, were also used for the annual statistics.

**3.5.3.1 Annual Means.** Annual mean values of the thermodynamic RRA quantities were calculated using the equation

$$Q_{ANN} = Q_A / N_Q$$

where $Q_A$ is the total of all observed values of $Q$ and $N_Q$ is the total number of observations of $Q$.

**3.5.3.2 Annual Standard Deviations and Skewness Values.** Annual standard deviations of the thermodynamic RRA quantities were calculated using equation 63. Annual skewness values were calculated with equation 64.

**NOTE**

**Both these quantities were previously calculated with monthly statistics because of limitations in computer precision.**

## 3.6 MONTHLY AND ANNUAL MEAN MODEL ATMOSPHERES

A set of modeled monthly mean and annual mean hydrostatic values of pressure and density was calculated from the lowest RRA data level (0 km, mean sea level) to 30 km, and from 30 km to 70 km. The integration from 0 to 30 km was computed independently of the integration from 30 to 70 km because of the difference in data sources. These hydrostatically modeled mean values (given in appendix D) are useful as a check on the validity of pressure and density values given in appendix B. In most cases, the values in appendixes B and D for any given data level are within 1 percent of each other. The hydrostatic pressure values in appendix D were calculated using the equation

$$p_1 = p_0 \exp\left(-\frac{0.034162\,(H_1 - H_0)}{0.5\,(T_{v_1} + T_{v_0})}\right) \qquad (65)$$

where, $H_1 - H_0$ is in meters and a "0" subscript refers to values at the RRA data level immediately below the level being checked. $p_0$ at the lowest data level is set equal to the RRA mean pressure; $p_1$, calculated for the next highest data level, is taken as $p_0$ for the

level above that. This process is repeated for all the other RRA data levels. The hydrostatic density corresponding to hydrostatic pressures is calculated from these pressures and from RRA virtual temperature values using the formula

$$\rho_H = 348.36786\, P_H / T_v \tag{66}$$

where $\rho_h$ and $P_H$ are the hydrostatic density and pressure shown in appendix D.

## 3.7 THERMODYNAMIC QUANTITIES DERIVABLE FROM TABLES

Several other quantities can be calculated from the statistics given in appendixes B and D. The equations in this section can be used to calculate approximate mean values of these quantities at each RRA data level. It is not possible, however, to infer or derive any information concerning standard deviation or skewness values of these quantities from the data in appendixes B and C.

**3.7.1 Mean Air Particle Speed.** The mean air particle speed, V, is the arithmetic average of the speeds of all air particles in the volume element being considered. For a valid average to occur, there must be a sufficient number of particles involved to represent mean conditions. The equation for V for dry air is

$$V = \sqrt{\frac{8}{\pi} \cdot \frac{R^* T}{M}} \tag{67}$$

Using tabulated values, a computational form for dry air is

$$V = \sqrt{7.3094 \times 10^2 \times T} \quad \text{(m/s)} \tag{68}$$

where T is the temperature in kelvin (K) from appendix B. Equation 67, when corrected for moist air, becomes

$$V = \sqrt{\frac{8}{\pi} \cdot R' T_v} \tag{69}$$

The computational form for moist air is

$$V = \sqrt{7.3094 \cdot 10^2 \cdot T_v} \quad \text{(m/s)} \tag{70}$$

where $T_V$ is the virtual temperature in kelvin (K) from appendix C.

**3.7.2 Mean Free Path.** The mean free path, L, is the mean value of the distance traveled by each neutral air particle, in a selected air parcel, between successive collisions with other particles in that parcel. A meaningful average requires that the selected parcel be large enough to contain a substantial number of particles. The equation for L is given by

$$L = \left(\frac{\sqrt{2}}{2\pi}\right)\left(\frac{R^* T}{N_a C_d^{\,2} P}\right) \tag{71}$$

where $C_d$ is the effective collision diameter of the mean air molecules. The 1976 standard atmosphere value of $3.65 \times 10^{-10}$ is valid for the range altitudes in the RRA. A computational form for moist air, using tabulated values is

$$L = 2.335 \times 10^{-7} \frac{T}{P} \text{ (meters)} \tag{72}$$

where T is the temperature in K and P is the pressure in mb, both from appendix B. A form of equation 71 to correct L for moist air is

$$L = \left(\frac{\sqrt{2}}{2\pi}\right) \frac{R' M T_v}{N_a C_d^2} \tag{73}$$

The computational form for moist air is

$$L = 2.3325 \times 10^{-7} \frac{T_v}{P} \text{ (meters)} \tag{74}$$

where $T_V$ is the virtual temperature in K from appendix C and P is the pressure in mb from appendix B.

**3.7.3 Mean Collision Frequency.** The mean collision frequency ($V_C$) is considered to be the average speed of air particles contained in an air parcel divided by the man free path of the particles inside that parcel. Computationally, this is equivalent to

$$V_c = \frac{V}{L} \ (sec^{-1}) \tag{75}$$

To determine $V_C$ for dry air, use V and L from equations 68 and 72. To determine $V_C$ for moist air, use V and L from equations 70 and 74.

**3.7.4 Speed of Sound.** The expression for the speed of sound ($C_S$) in dry air, in (m/s) is

$$C_s = \sqrt{\frac{\gamma R^* T}{M}} \tag{76}$$

To compute $C_S$ for dry air from tabulated values, use

$$C_s = \sqrt{4.0185 \times 10^2 \times T} \ \text{(m/s)} \tag{77}$$

where T is the temperature K from appendix B. One form for the speed of sound in moist air is

$$C_s = \sqrt{\gamma R' T_v} \tag{78}$$

where $T_v$ is the virtual temperature from appendix C. A computational form for moist air is

$$C_s = \sqrt{4.0185 \times 10^2 \, T_v} \ \text{(m/s)} \tag{79}$$

**3.7.5 Coefficient of Dynamic Viscosity.** The coefficient of dynamic viscosity, $\mu$ is defined as a coefficient internal friction developed where gas regions move adjacent to each other at different velocities. The following expression is taken from the U.S. Standard Atmosphere (1976):

$$\mu = \frac{\beta \cdot T^{3/2}}{T + S} \tag{80}$$

The computational form is

$$\mu = \frac{(1.458 \times 10^{-6}) \, T^{3/2}}{T + 110.4} \ , \left(\frac{kg}{s \cdot m}\right) \tag{81}$$

where T is temperature K from appendix B.

**3.7.6 Kinematic Coefficient of Viscosity.** The kinematic coefficient of viscosity, designated as $\eta$, is defined as the ratio of the dynamic coefficient of viscosity of a gas to its density, or

$$\eta = \mu/\rho \tag{82}$$

The computational form is

$$\eta = 1.0 \times 10^3 \, \mu/\rho \ , \ (m^2/s) \tag{83}$$

where $\mu$ is the dynamic coefficient of viscosity from equation (81) and $\rho$ is the density in g $m^{-3}$ from appendix B.

**3.7.7 Coefficient of Thermal Conductivity.** The empirical expression used for the coefficient of thermal conductivity ($K_t$) is given in the 1976 Standard Atmosphere as

$$K_t = \frac{2.65019 \times 10^{-3} \cdot T^{3/2}}{T + 245.4 \times 10^{-(12/T)}} \ , \ \text{(watts/m-deg K)} \tag{84}$$

where T is temperature K.

**3.7.8 Refractive Modulus and Refractive Index.**

The refractive modulus or refractivity (Selby and McClatchey, 1975; Smith and Weintraub, 1953) is expressed as N, where

$$N = (n - 1) \cdot 10^6 \tag{85}$$

and n is the refractive index.

For microwave frequencies below approximately 30 GHz (equivalent to wavelengths above 1 cm), N, the refractive modulus, is given by the empirical equation

$$N = 77.6 \frac{P}{T_d} + 3.73 \times 10^5 \frac{e}{T^2} \text{ (dimensionless)} \qquad (86)$$

where E and P are in millibars and T and $T_d$ are in K.

The following expression is valid for visible and infrared wavelengths shorter than approximately 30 μm (0.03 mm):

$$N = 77.6 \frac{P}{T} + 0.584 \frac{P}{T\nu} \text{ (diminsionless)} \qquad (87)$$

where λ is the wavelength in microns and T is in degrees K.

The expression for N for the wavelength from 0.03 mm to 1 cm is an extremely complex function of wavelength.

# Chapter 4

# CONCLUSIONS AND RECOMMENDATIONS

## 4.1 CONCLUSIONS

This document satisfies the technical objectives established for the Range Reference Atmosphere committee by the Range Commanders Council's Meteorology Group. Upper-air statistics and models for wind and thermodynamic quantities for the range specified have been derived through consistent uniform methods that will be used in similar publications for other ranges. This new Range Reference Atmosphere (RRA) series is an improvement over previously published RRAs. The upper-air data base is much larger and much better because more advanced statistical techniques have been employed.

In this series, a statistical measure of central tendency (mean values) and a measure of dispersion (standard deviation with respect to mean values) for monthly and annual reference periods have been consistently tabulated for all variables using data bases that have been carefully edited and quality controlled. Further, a statistical measure for symmetry (skewness coefficient which involves the third statistical moment) has been tabulated for all variables except the zonal and meridional wind components. But even with these improvements, RRA users must recognize certain limitations of the statistical tabulations. These limitations are described here to discourage misuse of the RRA.

- The wind profile structure with respect to altitude cannot be modeled from RRA statistics because inter-level and cross-level correlations were not computed.

- The profile structure with respect to altitude for any of the thermodynamic variables or quantities derivable from thermodynamic variables cannot be modeled because the prerequisite correlations were not computed. However, the profile of monthly and annual means for pressure, virtual temperature, and density given in appendix D are in agreement with the hydrostatic equation and the equation of state.

Although more extensive statistical tabulations are currently impractical, many adaptations of current statistics for specific engineering and scientific applications are envisioned as insight is gained through RRA use.

## 4.2 RECOMMENDATIONS

The Range Reference Atmosphere Committee responsible for RRA preparation recommends that the wind and thermodynamic statistical tabulations and models in this RRA be used with confidence as a standard reference to the atmosphere over the location for which it has been prepared. It is further recommended that RRA users consult their Staff Meteorologist for assistance before attempting to apply RRA data to specific engineering projects.

## BIBLIOGRAPHY


Buell, Eugene C., "Statistical Relations in a Perfect Gas," *Journal of Applied Meteorology*, 9, pp. 729-731, 1970.

List, R.J., Ed.," Acceleration of Gravity," *Smithsonian Meteorological Tables*, Sixth Ed. Smithsonian Institution, Washington, D.C., p. 488, 1968.

Selby, J.E.A., and McClatchey, R.A., *Atmospheric Transmittance from 0.25 to 28.5 μm-- Computer Code LOWTRAN 3*, AFCRL-TR-75-0255, Air Force Cambridge Research Laboratories, 1975.

Smith, E.K., and Weintraub, S., "The Constants in the Equation for Atmospheric Refractive Index at Radio Frequencies," *Proceedings of the Institute of Radio Engineers*, 41, 8, pp. 1035-1037, August 1953.

Smith, O.E., *Vector Wind and Vector Wind Shear Models at 0-27 km Altitude for Cape Kennedy, Florida, and Vandenberg AFB, California*, NASA TM X-73319, July 1976.

*U.S. Standard Atmosphere*, National Aeronautics and Space Administration, United States Air Force, and United States Weather Bureau; October 1976.

## ACRONYMS, INITIALISMS, AND ABBREVIATIONS (ACRINABs)

| | |
|---|---|
| AFDTC | Air Force Development Test Center |
| AFFTC | Air Force Flight Test Center |
| AFSC | Air Force Systems Command |
| AFSCF | Air Force Satellite Control Facility |
| AWS | Air Weather Service |
| BMD | Ballistic Missile Division |
| BMO | Ballistic Missile Organization |
| CSTC | Consolidated Space Test Center |
| DoD | Department of Defense |
| DoE | Department of Energy |
| DoE/NTS | DOE/Nevada Test Site |
| DPG | Dugway Proving Ground |
| EPG | Electronic Proving Ground |
| ESMC | Eastern Space and Missile Center |
| ETR | Eastern Test Range |
| GL | Geophysics Laboratory |
| IRIG | Inter-Range Instrumentation Group |
| NASA | National Aeronautics and Space Administration |
| NASA/MSFC | NASA/Marshall Space Flight Center |
| NASA/WFC | NASA/Wallops Flight Center |
| NATC | Naval Air Test Center |
| NOAA | National Oceanic and Atmospheric Administration |
| NWC | Naval Weapons Center |
| PMTC | Pacific Missile Test Center |
| RCC/MG | Range Commanders Council/Meteorology Group |
| RRA | Range Reference Atmosphere |
| RRAC | Range Reference Atmosphere Committee |
| TFWC | Tactical Fighter Weapons Center |
| USA/NTC | U.S. Army National Training Center |
| USACECOM | U.S. Army Communications-Electronics Command |
| USAFETAC | USAF Environmental Technical Applications Center |
| USAKA | U.S. Army Kwajalein Atoll |
| UTTR | Utah Test and Training Range |
| WSMC | Western Space and Missile Center |
| WSMR | White Sands Missile Range |
| WTR | Western Test Range |
| YPG | Yuma Proving Ground |
| 6585TG | 6585th Test Group |

## PREVIOUSLY PUBLISHED RANGE REFERENCE ATMOSPHERES

Cape Kennedy, Florida (Part I), Document 104-63, 16 April 1963
(AD 451 780).*

White Sands Missile Range, New Mexico (Part I), Document 104-63, 28 June 1964
(AD 451 781).*

Fort Churchill, Manitoba (Part I), Document 372-63, 7 August 1964
(AD 634 727).

Eniwetok, Marshall Islands (Part I), Document 104-63, 1 September 1964
(AD 479 264).*

Fort Greely Missile Range, Alaska (Part I), Document 373-63, 6 October 1964
(AD 634 726).

Eglin Gulf Test Range, Florida (Part I), Document 104-63, 25 January 1965
(AD 472 601).*

Point Arguello, California (Part I), Document 104-63, April 1965
(AD 472 602).*

Wallops Island Test Range (Part I), Document 104-63, 10 July 1965
(AD 474 071).*

Ascension Island, South Atlantic (Part I), Document 104-63, July 1966
(AD 645 591).*

Johnston Island Test Site (Part I), Document 104-63, January 1970
(AD 782 652).*

Lihue, Kauai, Hawaii (Part I), Document 104-63, January 1970
(AD 782 653).*

Cape Kennedy, Florida (Part II), Document 104-63, September 1971
(AD 753 581).*

White Sands Missile Range (Part II), Document 104-63, September 1971
(AD 782 654).*

Wallops Island Test Range (Part II), Document 104-63, September 1971.*

Fort Greely Missile Range (Part II), Document 104-63, September 1971.*

Edwards AFB (Part I), Document 104-63, September 1972
(AD 782 651).*

Kwajalein Missile Range, Marshall Islands (Part I), Document 105-63, October 1974.*

Kwajalein Missile Range, Document 360-82, 1982
(AD-A123424).

Cape Canaveral, Florida, Document 361-83, February 1983
(AD-A125553).

Vandenberg AFB, California, Document 362-83, 1983
(AD-A128125).

Dugway, Utah, Document 363-83, June 1983
(AD-A131110).

Wallops Island Test Range, Virginia, Document 364-83, July 1983
(AD-A131327).

White Sands Missile Range, New Mexico, Document 365-83, August 1983
(AD-A132471).

Edwards AFB, California, Document 366-83, August 1983
(AD-A132487).

Eglin AFB, Florida, Document 367-83, 1983
(AD-A133506).

Taquac, Guam Island, Document 368-83, 1983
(AD-A133618).

Point Mugu, California, Document 369-83, 1983
(AD-A134186).

Barking Sands, Hawaii, Document 370-83, 1983
(AD-A137406).

Ascension Island, Document 371-84, 1984
(AD-A138470).

* *No longer available from RCC.*

Wake Island, USAFETAC/PR-90/007, November 1990.
(AD-Pending)

Nellis, USAFETAC/PR-90/008, December 1990
(AD-Pending)

Shemya, USAFETAC/PR-91/003, January 1991
(AD-Pending)

Thule, USAFETAC/PR-91/006, February 1991
(AD-Pending)

Fairbanks, USAFETAC/PR-91/007, February 1991
(AD-Pending)

# APPENDIX A

## Nellis Wind Statistics Tables

Table A-1 through Table A-13 give statistical wind data (monthly and annual) for Nellis. Data was produced as described in Chapter 2.

## TABLE A-1. January Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | -1.47 | 2.92 | 0.3876 | -0.26 | 3.55 | 4.13 | 2.51 | 0.75 | 495. |
| 2.000 | -0.71 | 4.69 | 0.6013 | 0.09 | 6.66 | 6.89 | 4.14 | 0.86 | 550. |
| 3.000 | 2.13 | 6.93 | 0.4681 | -1.28 | 8.05 | 9.50 | 5.34 | 0.66 | 47. |
| 4.000 | 4.96 | 8.44 | 0.3158 | -2.68 | 8.92 | 11.87 | 6.43 | 0.67 | 540. |
| 5.000 | 7.51 | 9.62 | 0.2097 | -3.48 | 10.48 | 14.50 | 7.76 | 0.58 | 524. |
| 6.000 | 9.45 | 11.49 | 0.2127 | -3.93 | 11.94 | 17.19 | 9.13 | 0.64 | 510. |
| 7.000 | 11.31 | 13.10 | 0.2457 | -4.07 | 13.66 | 19.78 | 10.52 | 0.68 | 475. |
| 8.000 | 12.85 | 14.71 | 0.2670 | -4.74 | 15.37 | 22.41 | 11.72 | 0.68 | 469. |
| 9.000 | 14.27 | 16.24 | 0.2833 | -5.22 | 16.56 | 24.84 | 12.29 | 0.53 | 462. |
| 10.000 | 15.58 | 16.95 | 0.2726 | -6.04 | 17.01 | 26.37 | 12.62 | 0.52 | 453. |
| 11.000 | 17.38 | 16.85 | 0.2679 | -6.48 | 16.34 | 27.13 | 12.56 | 0.70 | 441. |
| 12.000 | 18.48 | 14.94 | 0.2884 | -6.20 | 14.32 | 25.95 | 11.60 | 0.52 | 436. |
| 13.000 | 19.36 | 12.91 | 0.2539 | -5.42 | 12.28 | 24.61 | 10.75 | 0.81 | 435. |
| 14.000 | 18.61 | 10.83 | 0.1821 | -4.94 | 10.81 | 22.66 | 9.55 | 0.72 | 434. |
| 15.000 | 16.79 | 9.41 | 0.1715 | -4.41 | 9.12 | 20.05 | 8.42 | 0.74 | 432. |
| 16.000 | 14.60 | 8.24 | 0.1433 | -3.88 | 7.47 | 17.18 | 7.52 | 0.91 | 432. |
| 17.000 | 12.21 | 7.21 | 0.0780 | -3.36 | 6.30 | 14.35 | 6.80 | 1.26 | 409. |
| 18.000 | 9.40 | 6.84 | 0.0053 | -3.24 | 5.24 | 11.45 | 6.47 | 1.58 | 409. |
| 19.000 | 6.76 | 6.99 | 0.0007 | -3.42 | 4.53 | 9.42 | 6.17 | 1.81 | 404. |
| 20.000 | 4.08 | 7.33 | 0.0099 | -3.53 | 4.08 | 8.00 | 5.14 | 1.21 | 400. |
| 21.000 | 2.03 | 8.08 | -0.0153 | -3.67 | 4.01 | 8.28 | 4.71 | 0.96 | 398. |
| 22.000 | 0.54 | 9.24 | -0.0179 | -3.86 | 4.00 | 9.27 | 4.87 | 1.17 | 387. |
| 23.000 | -0.67 | 9.98 | 0.0786 | -3.97 | 4.18 | 10.35 | 5.09 | 0.72 | 380. |
| 24.000 | -1.17 | 11.30 | 0.2189 | -4.19 | 4.55 | 11.57 | 5.76 | 0.51 | 373. |
| 25.000 | -1.16 | 12.77 | 0.3194 | -4.23 | 5.23 | 12.85 | 6.64 | 0.64 | 356. |
| 26.000 | -0.79 | 14.66 | 0.4375 | -4.26 | 6.14 | 14.44 | 7.90 | 0.67 | 341. |
| 27.000 | -0.15 | 16.34 | 0.4853 | -4.33 | 7.19 | 16.01 | 8.97 | 0.60 | 308. |
| 28.000 | 0.22 | 18.37 | 0.5005 | -4.42 | 8.08 | 17.75 | 10.31 | 0.77 | 273. |
| 29.000 | -0.26 | 19.89 | 0.5542 | -4.32 | 8.79 | 18.69 | 11.86 | 0.99 | 212. |
| 30.000 | -0.17 | 22.29 | 0.5049 | -4.60 | 9.12 | 20.28 | 13.71 | 1.17 | 173. |

## TABLE A-2. February Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | -0.57 | 3.19 | 0.4803 | 0.05 | 4.02 | 4.24 | 2.93 | 1.04 | 458. |
| 2.000 | 0.64 | 4.64 | 0.5795 | 1.16 | 7.07 | 7.09 | 4.79 | 1.13 | 509. |
| 3.000 | 3.71 | 6.14 | 0.4509 | -0.66 | 8.02 | 9.28 | 5.48 | 0.93 | 507. |
| 4.000 | 7.06 | 7.22 | 0.2727 | -2.19 | 8.78 | 11.82 | 6.63 | 0.74 | 501. |
| 5.000 | 9.67 | 8.47 | 0.2081 | -3.29 | 10.21 | 14.98 | 7.46 | 0.65 | 494. |
| 6.000 | 11.78 | 9.78 | 0.1549 | -3.94 | 11.79 | 17.66 | 8.76 | 0.76 | 475. |
| 7.000 | 14.46 | 10.77 | 0.1054 | -4.68 | 13.34 | 20.67 | 9.84 | 0.75 | 432. |
| 8.000 | 16.59 | 11.96 | 0.0610 | -5.65 | 14.69 | 23.39 | 10.87 | 0.49 | 426. |
| 9.000 | 18.71 | 13.23 | 0.0904 | -6.25 | 16.06 | 26.04 | 11.98 | 0.46 | 425. |
| 10.000 | 21.03 | 13.85 | 0.0814 | -6.89 | 16.70 | 28.38 | 12.42 | 0.28 | 423. |
| 11.000 | 22.94 | 14.11 | 0.0587 | -7.26 | 16.79 | 29.87 | 12.93 | 0.40 | 421. |
| 12.000 | 23.30 | 11.96 | 0.0833 | -6.71 | 14.63 | 28.66 | 11.09 | 0.37 | 417. |
| 13.000 | 23.53 | 10.23 | 0.1124 | -5.90 | 12.73 | 27.58 | 9.70 | 0.45 | 412. |
| 14.000 | 22.00 | 9.48 | 0.1087 | -5.06 | 11.26 | 25.38 | 9.06 | 0.64 | 412. |
| 15.000 | 19.79 | 8.48 | 0.0930 | -4.30 | 9.63 | 22.50 | 8.26 | 0.82 | 409. |
| 16.000 | 16.85 | 7.35 | 0.0855 | -3.33 | 8.00 | 19.00 | 7.20 | 0.68 | 405. |
| 17.000 | 13.99 | 7.08 | 0.0030 | -3.09 | 6.93 | 15.95 | 6.99 | 0.77 | 386. |
| 18.000 | 10.88 | 6.87 | -0.1051 | -2.74 | 5.94 | 12.68 | 6.89 | 0.98 | 385. |
| 19.000 | 7.93 | 6.62 | -0.1026 | -2.78 | 4.86 | 10.02 | 6.13 | 1.16 | 374. |
| 20.000 | 4.91 | 6.90 | -0.1246 | -2.58 | 4.36 | 8.18 | 5.51 | 1.53 | 374. |
| 21.000 | 2.53 | 7.30 | -0.0784 | -2.57 | 4.03 | 7.64 | 4.90 | 1.77 | 365. |
| 22.000 | 0.68 | 7.73 | -0.1221 | -2.80 | 3.72 | 7.88 | 4.43 | 1.71 | 352. |
| 23.000 | -0.97 | 8.17 | -0.1380 | -2.73 | 3.87 | 8.40 | 4.40 | 1.37 | 348. |
| 24.000 | -1.93 | 9.20 | -0.0487 | -2.65 | 4.06 | 9.28 | 5.07 | 0.92 | 340. |
| 25.000 | -2.16 | 10.40 | 0.0151 | -2.88 | 4.76 | 10.39 | 5.95 | 0.96 | 327. |
| 26.000 | -2.26 | 11.68 | 0.0983 | -3.20 | 5.11 | 11.49 | 6.73 | 0.60 | 310. |
| 27.000 | -2.09 | 13.45 | 0.1243 | -3.54 | 5.94 | 13.24 | 7.56 | 0.64 | 266. |
| 28.000 | -2.71 | 15.12 | 0.1993 | -3.52 | 6.51 | 14.70 | 8.58 | 0.71 | 233. |
| 29.000 | -2.24 | 18.03 | 0.2758 | -3.81 | 6.50 | 16.72 | 10.29 | 1.12 | 185. |
| 30.000 | -1.81 | 18.98 | 0.3974 | -3.79 | 6.61 | 17.73 | 10.26 | 0.75 | 144. |

## TABLE A-3. March Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | 0.30 | 3.28 | 0.5578 | 0.74 | 4.29 | 4.54 | 3.03 | 1.05 | 493. |
| 2.000 | 1.44 | 4.14 | 0.4453 | 1.66 | 6.91 | 7.04 | 4.48 | 0.97 | 553. |
| 3.000 | 3.61 | 5.32 | 0.3033 | 0.12 | 7.63 | 8.58 | 5.08 | 0.73 | 548. |
| 4.000 | 6.52 | 6.83 | 0.1800 | -1.17 | 9.07 | 11.38 | 6.55 | 0.81 | 543. |
| 5.000 | 9.40 | 8.53 | 0.0934 | -1.88 | 10.99 | 14.72 | 8.29 | 0.89 | 530. |
| 6.000 | 12.07 | 10.47 | 0.0513 | -2.13 | 12.89 | 18.02 | 10.05 | 1.04 | 516. |
| 7.000 | 14.07 | 12.09 | 0.0316 | -2.03 | 14.40 | 20.87 | 10.94 | 0.79 | 475. |
| 8.000 | 16.30 | 13.28 | 0.0714 | -2.12 | 16.00 | 23.61 | 12.02 | 0.57 | 470. |
| 9.000 | 18.12 | 14.35 | 0.0543 | -3.05 | 17.30 | 26.13 | 12.61 | 0.40 | 458. |
| 10.000 | 20.64 | 15.11 | 0.0650 | -2.83 | 17.67 | 28.17 | 13.42 | 0.43 | 453. |
| 11.000 | 22.48 | 14.51 | 0.0799 | -2.79 | 16.85 | 28.72 | 13.49 | 0.53 | 446. |
| 12.000 | 23.45 | 12.81 | 0.0965 | -1.44 | 14.36 | 27.81 | 12.16 | 0.52 | 439. |
| 13.000 | 23.51 | 11.08 | 0.1275 | -0.64 | 12.45 | 26.72 | 10.80 | 0.55 | 437. |
| 14.000 | 22.07 | 9.57 | 0.0926 | 0.02 | 10.79 | 24.68 | 9.26 | 0.62 | 435. |
| 15.000 | 19.91 | 8.04 | 0.0810 | 0.14 | 9.45 | 22.11 | 7.82 | 0.71 | 434. |
| 16.000 | 17.16 | 7.53 | 0.1205 | 0.31 | 8.12 | 19.06 | 7.34 | 0.88 | 432. |
| 17.000 | 14.34 | 6.83 | 0.1103 | 0.47 | 6.76 | 15.94 | 6.62 | 1.15 | 411. |
| 18.000 | 11.31 | 6.24 | 0.1251 | 0.53 | 5.57 | 12.63 | 6.21 | 1.40 | 411. |
| 19.000 | 8.54 | 5.99 | 0.1854 | 0.29 | 4.57 | 9.78 | 5.83 | 1.70 | 404. |
| 20.000 | 5.87 | 6.12 | 0.2230 | -0.10 | 3.86 | 7.59 | 5.39 | 2.21 | 400. |
| 21.000 | 3.90 | 6.38 | 0.1936 | -0.45 | 3.36 | 6.42 | 4.44 | 1.91 | 394. |
| 22.000 | 2.38 | 6.56 | 0.2234 | -0.72 | 3.11 | 6.13 | 3.84 | 1.88 | 387. |
| 23.000 | 1.19 | 7.14 | 0.2315 | -0.95 | 3.06 | 6.38 | 3.92 | 1.51 | 385. |
| 24.000 | 0.74 | 7.92 | 0.2193 | -1.11 | 3.07 | 6.96 | 5.04 | 1.86 | 367. |
| 25.000 | 0.69 | 8.86 | 0.2576 | -1.05 | 3.32 | 7.85 | 5.41 | 1.57 | 350. |
| 26.000 | 0.75 | 10.17 | 0.3159 | -1.00 | 3.80 | 9.06 | 6.10 | 1.08 | 337. |
| 27.000 | 1.84 | 11.95 | 0.4071 | -1.32 | 4.00 | 10.64 | 7.10 | 0.98 | 290. |
| 28.000 | 3.35 | 13.32 | 0.4738 | -1.16 | 4.28 | 11.88 | 8.17 | 0.98 | 267. |
| 29.000 | 5.01 | 15.20 | 0.5233 | -0.61 | 4.84 | 13.78 | 9.45 | 0.82 | 206. |
| 30.000 | 7.84 | 17.43 | 0.5291 | 0.04 | 5.52 | 16.51 | 11.03 | 0.63 | 150. |

## TABLE A-4. April Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | 0.52 | 3.36 | 0.5409 | 0.86 | 4.37 | 4.79 | 2.91 | 0.61 | 509. |
| 2.000 | 1.64 | 4.53 | 0.4050 | 2.09 | 6.72 | 7.20 | 4.18 | 0.96 | 546. |
| 3.000 | 3.06 | 5.49 | 0.1987 | 1.17 | 7.33 | 8.14 | 4.95 | 1.21 | 544. |
| 4.000 | 5.65 | 7.42 | 0.0101 | -0.11 | 8.87 | 11.03 | 6.62 | 1.18 | 530. |
| 5.000 | 8.54 | 9.41 | 0.0021 | -1.06 | 10.51 | 14.21 | 8.41 | 0.91 | 520. |
| 6.000 | 10.85 | 10.79 | 0.0389 | -1.41 | 12.29 | 17.07 | 9.77 | 0.76 | 513. |
| 7.000 | 13.30 | 12.63 | 0.0690 | -1.81 | 14.39 | 20.44 | 11.32 | 0.74 | 478. |
| 8.000 | 15.19 | 13.76 | 0.1137 | -1.99 | 16.00 | 23.06 | 12.15 | 0.66 | 472. |
| 9.000 | 16.90 | 14.78 | 0.1539 | -2.28 | 17.04 | 25.18 | 12.84 | 0.52 | 468. |
| 10.000 | 18.92 | 15.69 | 0.1824 | -2.49 | 17.28 | 26.99 | 13.42 | 0.60 | 462. |
| 11.000 | 20.10 | 15.39 | 0.1911 | -2.61 | 16.85 | 27.72 | 12.74 | 0.34 | 456. |
| 12.000 | 20.77 | 14.36 | 0.2327 | -1.73 | 14.98 | 26.97 | 11.68 | 0.44 | 452. |
| 13.000 | 20.17 | 12.25 | 0.2500 | -0.75 | 12.62 | 24.71 | 10.28 | 0.35 | 448. |
| 14.000 | 19.23 | 10.84 | 0.2688 | 0.13 | 10.44 | 22.56 | 9.34 | 0.39 | 447. |
| 15.000 | 17.43 | 9.60 | 0.2173 | 0.41 | 9.01 | 20.12 | 8.50 | 0.39 | 445. |
| 16.000 | 14.89 | 8.43 | 0.1709 | 0.86 | 7.47 | 17.02 | 7.73 | 0.50 | 442. |
| 17.000 | 12.78 | 7.45 | 0.1725 | 1.17 | 6.47 | 14.64 | 6.89 | 0.62 | 411. |
| 18.000 | 10.19 | 6.67 | 0.1651 | 1.22 | 5.60 | 11.91 | 6.26 | 0.90 | 411. |
| 19.000 | 7.57 | 6.13 | 0.2163 | 1.11 | 4.73 | 9.31 | 5.63 | 1.25 | 410. |
| 20.000 | 5.37 | 5.55 | 0.2727 | 0.85 | 4.04 | 7.18 | 5.02 | 1.67 | 406. |
| 21.000 | 3.59 | 5.48 | 0.2967 | 0.47 | 3.74 | 5.89 | 4.73 | 1.81 | 399. |
| 22.000 | 2.82 | 5.53 | 0.3236 | -0.01 | 3.49 | 5.64 | 4.35 | 1.84 | 393. |
| 23.000 | 2.13 | 5.69 | 0.3250 | -0.35 | 3.37 | 5.65 | 4.05 | 1.71 | 390. |
| 24.000 | 2.02 | 6.01 | 0.3062 | -0.39 | 3.35 | 5.71 | 4.33 | 1.77 | 376. |
| 25.000 | 2.80 | 6.40 | 0.3162 | -0.45 | 3.41 | 6.23 | 4.65 | 1.79 | 363. |
| 26.000 | 3.58 | 6.73 | 0.3251 | -0.64 | 3.50 | 6.68 | 5.10 | 1.66 | 345. |
| 27.000 | 4.97 | 6.96 | 0.3160 | -0.76 | 3.71 | 7.51 | 5.57 | 1.56 | 316. |
| 28.000 | 6.12 | 6.67 | 0.2160 | -0.67 | 3.83 | 8.13 | 5.55 | 1.44 | 286. |
| 29.000 | 7.43 | 6.84 | 0.1966 | -0.82 | 4.08 | 9.19 | 5.89 | 1.60 | 251. |
| 30.000 | 8.36 | 7.52 | 0.2038 | -0.73 | 4.65 | 10.31 | 6.49 | 1.76 | 202. |

## TABLE A-5. May Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | 0.71 | 3.23 | 0.5725 | 1.05 | 4.00 | 4.42 | 2.90 | 0.93 | 502. |
| 2.000 | 1.98 | 3.51 | 0.4957 | 2.58 | 5.64 | 6.39 | 3.73 | 1.04 | 530. |
| 3.000 | 2.31 | 3.88 | 0.2359 | 2.10 | 5.90 | 6.56 | 4.05 | 1.13 | 529. |
| 4.000 | 3.68 | 5.42 | 0.0460 | 1.24 | 6.72 | 8.20 | 4.73 | 0.89 | 527. |
| 5.000 | 6.13 | 7.76 | -0.0004 | 0.07 | 8.22 | 10.89 | 6.81 | 1.27 | 520. |
| 6.000 | 8.25 | 9.48 | -0.0397 | -0.46 | 9.26 | 13.15 | 8.41 | 1.34 | 515. |
| 7.000 | 10.06 | 10.60 | 0.0538 | -0.79 | 10.47 | 15.41 | 9.28 | 0.97 | 474. |
| 8.000 | 11.63 | 11.96 | 0.1130 | -1.14 | 11.88 | 17.71 | 10.34 | 0.92 | 469. |
| 9.000 | 13.12 | 13.17 | 0.1166 | -1.41 | 13.18 | 19.92 | 11.12 | 0.68 | 466. |
| 10.000 | 14.69 | 14.17 | 0.1456 | -1.82 | 14.32 | 21.96 | 11.93 | 0.61 | 464. |
| 11.000 | 15.88 | 14.43 | 0.2073 | -2.00 | 14.64 | 23.03 | 12.17 | 0.65 | 461. |
| 12.000 | 16.78 | 14.06 | 0.2221 | -1.47 | 13.53 | 23.00 | 11.60 | 0.71 | 458. |
| 13.000 | 16.12 | 11.89 | 0.2453 | -0.91 | 11.46 | 20.88 | 9.84 | 0.84 | 455. |
| 14.000 | 14.87 | 9.82 | 0.1870 | -0.18 | 9.17 | 18.18 | 8.42 | 1.20 | 455. |
| 15.000 | 12.95 | 8.38 | 0.1692 | 0.42 | 7.43 | 15.43 | 7.44 | 1.44 | 454. |
| 16.000 | 10.47 | 7.06 | 0.0917 | 0.88 | 6.17 | 12.32 | 6.32 | 1.33 | 454. |
| 17.000 | 8.06 | 5.92 | 0.0907 | 0.85 | 5.08 | 9.86 | 5.41 | 1.88 | 425. |
| 18.000 | 5.46 | 5.18 | 0.0845 | 0.64 | 4.07 | 7.10 | 3.77 | 1.75 | 425. |
| 19.000 | 2.91 | 4.90 | 0.0701 | 0.34 | 3.32 | 5.00 | 3.07 | 1.64 | 419. |
| 20.000 | 0.86 | 4.63 | 0.0104 | 0.11 | 2.75 | 3.84 | 2.09 | 1.05 | 419. |
| 21.000 | -0.74 | 4.51 | -0.0156 | -0.19 | 2.40 | 3.47 | 2.12 | 1.28 | 415. |
| 22.000 | -1.36 | 4.34 | -0.0516 | -0.37 | 2.27 | 3.51 | 2.11 | 1.11 | 412. |
| 23.000 | -1.72 | 4.40 | -0.0808 | -0.52 | 2.30 | 3.71 | 2.24 | 0.83 | 407. |
| 24.000 | -1.70 | 4.71 | -0.0486 | -0.56 | 2.48 | 3.79 | 2.20 | 0.93 | 396. |
| 25.000 | -1.59 | 4.07 | -0.0105 | -0.72 | 2.37 | 3.87 | 2.23 | 0.61 | 376. |
| 26.000 | -1.38 | 4.39 | -0.0639 | -0.63 | 2.48 | 4.19 | 2.40 | 1.00 | 364. |
| 27.000 | -0.91 | 4.70 | -0.0157 | -0.63 | 2.66 | 4.43 | 2.73 | 1.59 | 341. |
| 28.000 | -0.30 | 5.22 | 0.0022 | -0.46 | 2.86 | 4.85 | 2.93 | 1.43 | 310. |
| 29.000 | -0.02 | 5.58 | 0.0480 | -0.37 | 2.97 | 5.17 | 3.04 | 1.27 | 271. |
| 30.000 | 0.19 | 6.06 | 0.0398 | -0.39 | 3.00 | 5.55 | 3.21 | 0.95 | 234. |

## TABLE A-6. June Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | 1.31 | 3.15 | 0.6179 | 1.75 | 4.21 | 4.88 | 2.93 | 0.60 | 566. |
| 2.000 | 2.45 | 3.39 | 0.5970 | 4.42 | 5.41 | 7.21 | 3.77 | 0.60 | 587. |
| 3.000 | 2.42 | 3.79 | 0.3528 | 4.09 | 5.60 | 7.12 | 4.18 | 1.02 | 587. |
| 4.000 | 3.27 | 5.26 | 0.1513 | 3.52 | 6.09 | 8.01 | 4.60 | 0.90 | 583. |
| 5.000 | 5.69 | 6.64 | 0.0833 | 3.10 | 7.02 | 10.08 | 5.81 | 1.04 | 574. |
| 6.000 | 8.12 | 7.88 | 0.0710 | 2.94 | 8.13 | 12.30 | 7.17 | 0.99 | 571. |
| 7.000 | 10.29 | 8.90 | 0.1173 | 3.18 | 9.36 | 14.51 | 8.50 | 1.00 | 527. |
| 8.000 | 12.27 | 10.32 | 0.1550 | 3.60 | 10.69 | 16.87 | 9.98 | 1.01 | 526. |
| 9.000 | 13.98 | 11.45 | 0.1689 | 3.96 | 11.76 | 18.98 | 10.95 | 0.85 | 525. |
| 10.000 | 15.66 | 12.75 | 0.2482 | 4.26 | 12.66 | 21.10 | 11.86 | 0.83 | 522. |
| 11.000 | 16.90 | 13.15 | 0.2768 | 4.77 | 13.26 | 22.67 | 11.95 | 0.63 | 513. |
| 12.000 | 18.20 | 12.85 | 0.2692 | 5.14 | 13.22 | 23.55 | 11.92 | 0.47 | 512. |
| 13.000 | 18.42 | 11.62 | 0.2595 | 5.69 | 11.91 | 23.05 | 10.81 | 0.32 | 508. |
| 14.000 | 16.99 | 9.51 | 0.2211 | 5.69 | 10.14 | 20.78 | 9.06 | 0.39 | 503. |
| 15.000 | 14.00 | 7.39 | 0.2113 | 5.01 | 8.16 | 17.11 | 7.02 | 0.26 | 502. |
| 16.000 | 10.02 | 5.72 | 0.1735 | 3.94 | 6.02 | 12.45 | 5.45 | 0.64 | 498. |
| 17.000 | 6.40 | 4.68 | 0.1114 | 2.94 | 4.65 | 8.69 | 4.18 | 1.17 | 473. |
| 18.000 | 3.12 | 4.10 | 0.1269 | 2.15 | 3.66 | 5.78 | 3.34 | 1.74 | 473. |
| 19.000 | -0.08 | 3.81 | 0.2342 | 1.24 | 2.94 | 4.09 | 2.49 | 1.28 | 469. |
| 20.000 | -2.34 | 3.65 | 0.2929 | 0.57 | 2.48 | 4.41 | 2.25 | 1.04 | 466. |
| 21.000 | -3.99 | 3.32 | 0.1932 | 0.12 | 2.11 | 5.06 | 2.39 | 0.55 | 464. |
| 22.000 | -5.41 | 2.98 | 0.1493 | -0.09 | 1.89 | 6.04 | 2.27 | 0.14 | 461. |
| 23.000 | -6.51 | 3.00 | 0.0608 | -0.17 | 1.86 | 7.00 | 2.42 | -0.09 | 456. |
| 24.000 | -7.15 | 3.43 | 0.1476 | -0.30 | 1.93 | 7.61 | 2.95 | 0.08 | 451. |
| 25.000 | -7.73 | 3.35 | 0.0821 | -0.36 | 1.94 | 8.12 | 2.98 | 0.13 | 438. |
| 26.000 | -8.34 | 3.52 | 0.0614 | -0.41 | 1.88 | 8.71 | 3.14 | 0.17 | 425. |
| 27.000 | -8.72 | 3.81 | 0.0709 | 0.02 | 2.16 | 9.14 | 3.42 | -0.04 | 399. |
| 28.000 | -9.04 | 4.26 | 0.2296 | -0.03 | 2.36 | 9.37 | 3.26 | -0.04 | 365. |
| 29.000 | -9.50 | 3.84 | 0.1461 | -0.13 | 2.45 | 9.97 | 3.40 | 0.09 | 319. |
| 30.000 | -9.98 | 4.03 | 0.1466 | 0.01 | 2.30 | 10.42 | 3.54 | 0.23 | 269. |

## TABLE A-7. July Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | 1.06 | 3.25 | 0.5830 | 1.88 | 3.58 | 4.46 | 2.85 | 0.64 | 598. |
| 2.000 | 2.44 | 2.72 | 0.4827 | 5.03 | 4.07 | 6.54 | 3.53 | 0.56 | 615. |
| 3.000 | 1.58 | 3.29 | 0.4621 | 4.97 | 4.52 | 6.55 | 3.95 | 0.99 | 614. |
| 4.000 | 1.36 | 4.37 | 0.3286 | 4.67 | 4.44 | 6.84 | 3.95 | 1.06 | 610. |
| 5.000 | 2.46 | 5.31 | 0.2388 | 4.56 | 5.06 | 7.86 | 4.33 | 1.00 | 600. |
| 6.000 | 4.06 | 5.95 | 0.1996 | 4.54 | 5.61 | 8.93 | 4.92 | 0.74 | 595. |
| 7.000 | 6.03 | 6.97 | 0.1985 | 5.27 | 6.33 | 10.75 | 6.10 | 0.85 | 560. |
| 8.000 | 7.51 | 7.75 | 0.1716 | 5.81 | 7.35 | 12.50 | 6.93 | 0.59 | 548. |
| 9.000 | 8.88 | 8.63 | 0.1806 | 6.63 | 8.40 | 14.29 | 7.98 | 0.81 | 547. |
| 10.000 | 10.22 | 9.41 | 0.0829 | 7.87 | 9.16 | 16.13 | 8.35 | 0.52 | 545. |
| 11.000 | 11.71 | 10.16 | 0.0717 | 9.10 | 9.96 | 18.28 | 9.39 | 0.81 | 544. |
| 12.000 | 12.61 | 10.26 | 0.1050 | 9.38 | 10.24 | 19.00 | 9.79 | 0.63 | 541. |
| 13.000 | 12.66 | 10.37 | 0.1598 | 8.88 | 10.12 | 18.64 | 10.06 | 0.69 | 540. |
| 14.000 | 11.19 | 9.19 | 0.2008 | 7.60 | 9.08 | 16.39 | 9.02 | 0.72 | 539. |
| 15.000 | 8.14 | 7.25 | 0.1880 | 5.97 | 7.16 | 12.59 | 6.87 | 0.53 | 539. |
| 16.000 | 4.12 | 5.25 | 0.1859 | 4.50 | 5.51 | 8.50 | 4.78 | 0.74 | 537. |
| 17.000 | 1.09 | 4.24 | 0.1797 | 3.25 | 4.02 | 5.99 | 3.17 | 0.82 | 503. |
| 18.000 | -1.53 | 3.32 | 0.2594 | 2.22 | 3.09 | 4.73 | 2.33 | 0.38 | 503. |
| 19.000 | -3.95 | 2.79 | 0.2782 | 1.16 | 2.49 | 5.13 | 2.15 | 0.50 | 503. |
| 20.000 | -6.09 | 2.25 | 0.2314 | 0.49 | 2.06 | 6.53 | 2.00 | -0.11 | 501. |
| 21.000 | -7.92 | 2.45 | 0.1205 | 0.14 | 1.98 | 8.20 | 2.32 | -0.30 | 499. |
| 22.000 | -9.11 | 2.19 | 0.0721 | -0.08 | 1.87 | 9.32 | 2.10 | -0.28 | 492. |
| 23.000 | -10.43 | 2.26 | 0.0620 | -0.24 | 1.78 | 10.60 | 2.18 | -0.17 | 489. |
| 24.000 | -11.71 | 2.42 | 0.0981 | -0.19 | 1.86 | 11.87 | 2.34 | -0.17 | 480. |
| 25.000 | -12.56 | 2.57 | 0.1804 | -0.14 | 1.88 | 12.73 | 2.43 | -0.33 | 463. |
| 26.000 | -13.36 | 2.62 | 0.1640 | -0.21 | 2.00 | 13.55 | 2.46 | -0.41 | 451. |
| 27.000 | -14.24 | 2.80 | 0.0780 | -0.05 | 2.09 | 14.42 | 2.67 | -0.45 | 428. |
| 28.000 | -14.94 | 2.67 | 0.1049 | 0.18 | 2.15 | 15.11 | 2.55 | -0.76 | 374. |
| 29.000 | -15.54 | 2.80 | 0.1614 | 0.04 | 2.32 | 15.74 | 2.66 | -0.71 | 338. |
| 30.000 | -16.47 | 3.07 | 0.1564 | 0.06 | 2.48 | 16.69 | 2.91 | -0.44 | 293. |

## TABLE A-8. August Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | 0.94 | 2.96 | 0.5594 | 1.94 | 3.36 | 4.11 | 2.79 | 0.65 | 548. |
| 2.000 | 2.39 | 2.65 | 0.4657 | 5.02 | 3.79 | 6.38 | 3.41 | 0.33 | 567. |
| 3.000 | 1.39 | 3.48 | 0.4111 | 4.73 | 4.14 | 6.39 | 3.56 | 0.83 | 567. |
| 4.000 | 0.97 | 4.38 | 0.2695 | 4.46 | 4.44 | 6.86 | 3.55 | 0.76 | 566. |
| 5.000 | 2.38 | 5.22 | 0.1967 | 4.20 | 5.09 | 7.82 | 3.90 | 0.69 | 562. |
| 6.000 | 3.90 | 5.86 | 0.1717 | 4.03 | 5.69 | 8.86 | 4.42 | 0.55 | 559. |
| 7.000 | 5.60 | 6.48 | 0.1838 | 4.63 | 6.24 | 10.36 | 5.11 | 0.65 | 547. |
| 8.000 | 7.20 | 7.22 | 0.1572 | 5.55 | 6.88 | 12.06 | 6.05 | 0.52 | 547. |
| 9.000 | 8.83 | 7.93 | 0.0978 | 6.76 | 7.84 | 14.12 | 6.95 | 0.50 | 545. |
| 10.000 | 10.60 | 8.98 | 0.0285 | 8.51 | 8.80 | 16.73 | 7.94 | 0.47 | 544. |
| 11.000 | 12.25 | 9.91 | -0.0212 | 10.16 | 9.96 | 19.33 | 8.76 | 0.30 | 543. |
| 12.000 | 13.53 | 10.48 | -0.0633 | 11.51 | 10.82 | 21.33 | 9.35 | 0.31 | 540. |
| 13.000 | 13.72 | 10.06 | -0.0319 | 11.17 | 10.41 | 21.02 | 8.99 | 0.28 | 539. |
| 14.000 | 12.36 | 8.69 | 0.0040 | 9.26 | 8.23 | 18.07 | 7.41 | 0.26 | 538. |
| 15.000 | 9.42 | 7.09 | -0.0294 | 7.17 | 6.42 | 14.03 | 5.89 | 0.21 | 534. |
| 16.000 | 5.31 | 5.21 | -0.0137 | 5.06 | 4.94 | 9.30 | 4.33 | 0.61 | 532. |
| 17.000 | 2.30 | 4.14 | 0.0218 | 3.53 | 3.72 | 6.29 | 2.84 | 0.58 | 483. |
| 18.000 | -0.36 | 3.67 | 0.1346 | 2.20 | 2.76 | 4.61 | 2.01 | 0.30 | 483. |
| 19.000 | -2.90 | 3.18 | 0.1652 | 1.09 | 2.49 | 4.57 | 2.23 | 0.60 | 483. |
| 20.000 | -4.79 | 2.59 | 0.1783 | 0.45 | 2.04 | 5.43 | 2.15 | -0.07 | 482. |
| 21.000 | -6.28 | 2.63 | 0.0564 | 0.07 | 1.99 | 6.67 | 2.40 | -0.09 | 481. |
| 22.000 | -7.60 | 2.23 | 0.1316 | -0.11 | 1.75 | 7.82 | 2.15 | -0.13 | 479. |
| 23.000 | -8.92 | 2.25 | 0.0498 | -0.37 | 1.69 | 9.09 | 2.21 | -0.18 | 475. |
| 24.000 | -10.27 | 2.60 | 0.0030 | -0.39 | 1.87 | 10.46 | 2.56 | -0.26 | 468. |
| 25.000 | -11.11 | 2.63 | 0.0043 | -0.21 | 1.96 | 11.30 | 2.59 | -0.28 | 455. |
| 26.000 | -11.80 | 2.77 | 0.0383 | -0.19 | 1.90 | 11.96 | 2.72 | -0.25 | 438. |
| 27.000 | -12.57 | 3.12 | 0.0605 | -0.16 | 2.09 | 12.76 | 3.06 | -0.08 | 414. |
| 28.000 | -13.18 | 3.14 | 0.0327 | -0.05 | 1.93 | 13.33 | 3.09 | -0.20 | 396. |
| 29.000 | -13.74 | 3.27 | 0.0936 | 0.05 | 2.07 | 13.90 | 3.25 | -0.18 | 355. |
| 30.000 | -14.16 | 3.73 | 0.1223 | -0.01 | 2.31 | 14.41 | 3.46 | -0.27 | 310. |

## TABLE A-9. September Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | 0.53 | 2.99 | 0.5313 | 1.54 | 3.70 | 4.22 | 2.72 | 0.74 | 512. |
| 2.000 | 1.67 | 3.27 | 0.5671 | 4.28 | 5.03 | 6.54 | 3.79 | 0.69 | 550. |
| 3.000 | 2.01 | 3.76 | 0.4068 | 4.44 | 5.89 | 7.27 | 4.45 | 0.85 | 549. |
| 4.000 | 3.19 | 5.21 | 0.2579 | 3.88 | 6.34 | 8.22 | 4.99 | 0.75 | 545. |
| 5.000 | 4.99 | 6.65 | 0.1709 | 3.43 | 7.15 | 9.82 | 5.95 | 0.70 | 541. |
| 6.000 | 6.75 | 7.89 | 0.1777 | 3.50 | 8.32 | 11.68 | 7.26 | 0.88 | 539. |
| 7.000 | 8.87 | 9.32 | 0.2118 | 3.84 | 9.80 | 14.07 | 8.84 | 0.99 | 529. |
| 8.000 | 10.77 | 10.57 | 0.2409 | 4.18 | 11.33 | 16.37 | 10.27 | 1.00 | 526. |
| 9.000 | 12.41 | 11.31 | 0.2518 | 4.49 | 12.67 | 18.58 | 10.83 | 0.88 | 523. |
| 10.000 | 14.34 | 11.81 | 0.2752 | 4.60 | 13.63 | 20.67 | 11.17 | 0.57 | 523. |
| 11.000 | 16.41 | 11.78 | 0.2681 | 5.12 | 13.34 | 22.13 | 11.06 | 0.47 | 522. |
| 12.000 | 17.71 | 11.34 | 0.2361 | 5.47 | 12.49 | 22.69 | 10.62 | 0.31 | 520. |
| 13.000 | 18.27 | 10.54 | 0.1895 | 5.60 | 11.03 | 22.29 | 10.02 | 0.33 | 517. |
| 14.000 | 17.30 | 9.13 | 0.1445 | 5.21 | 9.44 | 20.56 | 8.73 | 0.12 | 514. |
| 15.000 | 14.49 | 7.52 | 0.1441 | 4.45 | 7.75 | 17.15 | 7.20 | 0.20 | 511. |
| 16.000 | 10.78 | 6.31 | 0.1400 | 3.23 | 6.23 | 12.96 | 6.10 | 0.52 | 510. |
| 17.000 | 7.50 | 5.65 | 0.1753 | 2.16 | 5.35 | 9.63 | 5.35 | 1.03 | 472. |
| 18.000 | 4.38 | 4.85 | 0.2468 | 1.27 | 4.38 | 6.63 | 4.12 | 1.65 | 472. |
| 19.000 | 1.77 | 4.53 | 0.3234 | 0.48 | 3.67 | 4.80 | 3.24 | 1.65 | 465. |
| 20.000 | 0.27 | 4.39 | 0.3361 | 0.14 | 3.11 | 4.43 | 2.78 | 1.56 | 465. |
| 21.000 | -1.04 | 4.01 | 0.1981 | -0.16 | 2.56 | 4.22 | 2.44 | 1.38 | 462. |
| 22.000 | -1.95 | 4.06 | 0.2436 | -0.27 | 2.36 | 4.55 | 2.27 | 0.55 | 458. |
| 23.000 | -2.73 | 4.29 | 0.2194 | -0.37 | 2.25 | 5.05 | 2.34 | 0.27 | 451. |
| 24.000 | -3.29 | 4.52 | 0.1847 | -0.30 | 2.22 | 5.37 | 2.72 | 0.30 | 447. |
| 25.000 | -3.67 | 4.62 | 0.1685 | -0.08 | 2.10 | 5.59 | 2.82 | 0.28 | 430. |
| 26.000 | -4.11 | 4.74 | 0.1383 | -0.07 | 2.09 | 5.91 | 2.97 | 0.29 | 422. |
| 27.000 | -4.22 | 4.91 | 0.1304 | 0.02 | 2.20 | 6.06 | 3.16 | 0.36 | 389. |
| 28.000 | -4.09 | 5.25 | 0.2442 | 0.11 | 2.33 | 6.23 | 3.29 | 0.42 | 369. |
| 29.000 | -4.00 | 5.61 | 0.3382 | 0.05 | 2.46 | 6.51 | 3.34 | 0.61 | 321. |
| 30.000 | -3.79 | 6.05 | 0.3658 | -0.01 | 2.58 | 6.65 | 3.64 | 0.56 | 277. |

## TABLE A-10. October Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | -0.19 | 2.98 | 0.5963 | 0.44 | 3.69 | 3.88 | 2.77 | 1.04 | 569. |
| 2.000 | 0.22 | 4.07 | 0.5563 | 1.11 | 5.77 | 5.77 | 4.22 | 1.50 | 600. |
| 3.000 | 0.82 | 5.06 | 0.3743 | 0.31 | 6.43 | 6.93 | 4.42 | 1.07 | 600. |
| 4.000 | 2.84 | 6.76 | 0.2324 | -0.67 | 7.35 | 8.80 | 5.53 | 0.99 | 595. |
| 5.000 | 4.96 | 8.50 | 0.1229 | -1.31 | 8.65 | 11.08 | 7.10 | 1.11 | 586. |
| 6.000 | 6.81 | 10.23 | 0.1294 | -1.98 | 10.60 | 13.74 | 8.85 | 1.17 | 580. |
| 7.000 | 8.67 | 11.97 | 0.1372 | -2.36 | 12.84 | 16.45 | 10.84 | 1.26 | 545. |
| 8.000 | 10.01 | 13.27 | 0.1645 | -2.16 | 13.46 | 18.28 | 11.30 | 0.98 | 538. |
| 9.000 | 11.45 | 14.21 | 0.1921 | -2.08 | 14.82 | 20.21 | 12.17 | 0.81 | 535. |
| 10.000 | 13.26 | 15.14 | 0.2561 | -1.93 | 15.67 | 22.32 | 12.47 | 0.55 | 528. |
| 11.000 | 15.08 | 15.03 | 0.2405 | -1.90 | 15.40 | 23.16 | 12.51 | 0.48 | 526. |
| 12.000 | 16.12 | 14.04 | 0.2219 | -1.45 | 14.07 | 22.80 | 11.70 | 0.37 | 521. |
| 13.000 | 16.23 | 13.15 | 0.2096 | -1.21 | 12.22 | 21.56 | 11.04 | 0.50 | 514. |
| 14.000 | 14.82 | 10.89 | 0.1781 | -1.06 | 10.16 | 18.79 | 9.43 | 0.41 | 512. |
| 15.000 | 13.22 | 9.63 | 0.1286 | -0.68 | 8.48 | 16.33 | 8.55 | 0.79 | 506. |
| 16.000 | 11.12 | 8.02 | 0.1834 | -0.39 | 6.94 | 13.59 | 7.18 | 0.72 | 504. |
| 17.000 | 9.27 | 6.90 | 0.2331 | -0.42 | 5.85 | 11.48 | 6.00 | 0.85 | 457. |
| 18.000 | 6.90 | 6.05 | 0.2732 | -0.45 | 4.90 | 9.11 | 5.03 | 1.25 | 457. |
| 19.000 | 5.04 | 5.60 | 0.3178 | -0.42 | 4.54 | 7.64 | 4.37 | 1.60 | 454. |
| 20.000 | 3.72 | 5.17 | 0.3226 | -0.82 | 3.72 | 6.38 | 3.30 | 1.27 | 453. |
| 21.000 | 2.93 | 5.10 | 0.2913 | -0.85 | 3.49 | 5.87 | 3.59 | 1.76 | 450. |
| 22.000 | 3.10 | 4.90 | 0.3727 | -0.70 | 3.14 | 5.71 | 2.95 | 0.97 | 446. |
| 23.000 | 3.74 | 4.92 | 0.3128 | -0.64 | 3.02 | 6.05 | 3.33 | 1.48 | 439. |
| 24.000 | 4.66 | 5.23 | 0.2496 | -0.35 | 2.95 | 6.48 | 3.98 | 1.24 | 425. |
| 25.000 | 6.12 | 5.12 | 0.3070 | -0.11 | 2.92 | 7.38 | 4.20 | 0.79 | 407. |
| 26.000 | 8.00 | 5.29 | 0.2714 | 0.25 | 2.98 | 8.87 | 4.72 | 0.41 | 395. |
| 27.000 | 9.70 | 5.88 | 0.2041 | 0.41 | 3.07 | 10.46 | 5.37 | 0.25 | 373. |
| 28.000 | 10.89 | 6.42 | 0.2795 | 0.63 | 3.19 | 11.70 | 5.77 | 0.29 | 347. |
| 29.000 | 12.25 | 6.85 | 0.2695 | 0.99 | 3.37 | 13.06 | 6.22 | 0.29 | 303. |
| 30.000 | 13.84 | 7.21 | 0.2596 | 1.54 | 3.62 | 14.67 | 6.62 | 0.19 | 256. |

## TABLE A-11. November Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | -0.66 | 2.87 | 0.4699 | 0.55 | 3.74 | 3.92 | 2.76 | 1.12 | 550. |
| 2.000 | 0.47 | 4.49 | 0.5765 | 1.57 | 7.07 | 7.29 | 4.43 | 0.96 | 578. |
| 3.000 | 3.97 | 6.34 | 0.4247 | -0.27 | 8.37 | 9.85 | 5.38 | 0.88 | 575. |
| 4.000 | 7.70 | 7.79 | 0.2271 | -2.09 | 9.63 | 13.05 | 6.83 | 0.59 | 570. |
| 5.000 | 10.78 | 9.44 | 0.1478 | -2.99 | 11.79 | 16.71 | 8.61 | 0.52 | 558. |
| 6.000 | 13.17 | 10.68 | 0.1174 | -3.54 | 13.82 | 19.81 | 9.92 | 0.58 | 552. |
| 7.000 | 15.17 | 12.30 | 0.1219 | -3.70 | 15.75 | 22.72 | 11.24 | 0.56 | 525. |
| 8.000 | 16.92 | 13.02 | 0.1519 | -4.21 | 17.41 | 25.17 | 11.93 | 0.49 | 513. |
| 9.000 | 18.86 | 13.51 | 0.1655 | -4.53 | 18.69 | 27.46 | 12.37 | 0.32 | 504. |
| 10.000 | 20.68 | 13.86 | 0.2035 | -5.29 | 19.23 | 29.33 | 12.50 | 0.18 | 495. |
| 11.000 | 22.16 | 14.42 | 0.2282 | -5.80 | 18.64 | 30.33 | 12.63 | 0.17 | 484. |
| 12.000 | 23.14 | 13.65 | 0.2282 | -5.41 | 17.30 | 30.19 | 11.76 | 0.18 | 481. |
| 13.000 | 22.60 | 12.41 | 0.2356 | -4.36 | 15.31 | 28.36 | 10.63 | 0.32 | 476. |
| 14.000 | 21.11 | 10.84 | 0.2473 | -3.85 | 13.14 | 25.69 | 9.50 | 0.43 | 472. |
| 15.000 | 19.08 | 9.11 | 0.2760 | -3.06 | 11.15 | 22.67 | 8.17 | 0.43 | 469. |
| 16.000 | 16.50 | 7.94 | 0.2728 | -2.44 | 9.25 | 19.28 | 7.40 | 0.53 | 468. |
| 17.000 | 13.94 | 7.03 | 0.2746 | -1.97 | 7.93 | 16.22 | 6.88 | 0.95 | 437. |
| 18.000 | 11.12 | 6.32 | 0.2416 | -1.66 | 6.59 | 12.95 | 6.48 | 1.39 | 437. |
| 19.000 | 8.77 | 5.88 | 0.2332 | -1.64 | 5.52 | 10.41 | 6.02 | 1.85 | 434. |
| 20.000 | 6.97 | 5.75 | 0.2069 | -1.61 | 4.59 | 8.54 | 5.68 | 2.14 | 434. |
| 21.000 | 5.58 | 5.90 | 0.1752 | -1.47 | 3.98 | 7.33 | 5.48 | 2.17 | 430. |
| 22.000 | 5.04 | 6.04 | 0.1761 | -1.32 | 3.56 | 6.96 | 5.27 | 2.22 | 423. |
| 23.000 | 4.78 | 6.32 | 0.1574 | -1.11 | 3.39 | 6.97 | 5.18 | 2.02 | 420. |
| 24.000 | 4.88 | 7.24 | 0.2266 | -0.73 | 3.41 | 7.47 | 5.70 | 1.92 | 410. |
| 25.000 | 5.48 | 8.04 | 0.2834 | -0.52 | 3.52 | 8.19 | 5.84 | 1.67 | 396. |
| 26.000 | 5.91 | 8.89 | 0.3009 | -0.46 | 3.77 | 9.02 | 6.85 | 1.76 | 381. |
| 27.000 | 7.16 | 10.37 | 0.3162 | -0.35 | 3.97 | 10.61 | 7.88 | 1.53 | 354. |
| 28.000 | 8.66 | 11.44 | 0.3794 | -0.10 | 4.51 | 12.35 | 8.57 | 1.20 | 321. |
| 29.000 | 10.24 | 12.88 | 0.4392 | 0.12 | 5.36 | 14.24 | 9.81 | 1.14 | 264. |
| 30.000 | 11.73 | 14.51 | 0.3632 | -0.22 | 6.43 | 16.11 | 11.38 | 1.22 | 211. |

## TABLE A-12. December Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U;V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | -1.10 | 2.66 | 0.2542 | -0.10 | 3.20 | 3.54 | 2.44 | 1.12 | 586. |
| 2.000 | -0.08 | 4.36 | 0.4932 | 0.28 | 6.30 | 6.58 | 3.93 | 0.89 | 614. |
| 3.000 | 3.43 | 6.65 | 0.2835 | -1.26 | 7.91 | 9.59 | 5.30 | 0.75 | 610. |
| 4.000 | 6.76 | 8.10 | 0.1462 | -2.86 | 9.24 | 12.56 | 6.85 | 0.78 | 600. |
| 5.000 | 9.29 | 9.76 | 0.0780 | -3.84 | 10.95 | 15.57 | 8.58 | 0.77 | 586. |
| 6.000 | 11.33 | 11.27 | 0.0865 | -4.00 | 12.57 | 18.11 | 10.05 | 0.77 | 563. |
| 7.000 | 12.71 | 12.75 | 0.1577 | -4.54 | 14.21 | 20.49 | 11.23 | 0.73 | 536. |
| 8.000 | 14.51 | 13.97 | 0.1820 | -5.15 | 15.61 | 22.92 | 12.24 | 0.75 | 524. |
| 9.000 | 16.56 | 15.31 | 0.1936 | -5.60 | 16.89 | 25.67 | 12.88 | 0.56 | 518. |
| 10.000 | 18.55 | 16.40 | 0.1839 | -6.07 | 17.29 | 27.82 | 13.21 | 0.48 | 511. |
| 11.000 | 20.40 | 16.37 | 0.1847 | -6.66 | 16.49 | 28.77 | 13.12 | 0.43 | 504. |
| 12.000 | 21.02 | 14.96 | 0.1778 | -6.60 | 14.68 | 27.77 | 12.36 | 0.45 | 497. |
| 13.000 | 20.79 | 13.22 | 0.1710 | -5.71 | 13.41 | 26.24 | 11.40 | 0.46 | 492. |
| 14.000 | 19.56 | 11.03 | 0.1867 | -5.20 | 11.60 | 23.81 | 9.94 | 0.40 | 489. |
| 15.000 | 17.73 | 9.46 | 0.2208 | -4.70 | 10.18 | 21.36 | 8.56 | 0.43 | 487. |
| 16.000 | 15.29 | 8.37 | 0.2168 | -4.38 | 8.66 | 18.42 | 7.64 | 0.67 | 485. |
| 17.000 | 12.84 | 7.46 | 0.2467 | -4.03 | 7.54 | 15.67 | 6.40 | 0.72 | 448. |
| 18.000 | 10.20 | 7.08 | 0.2029 | -3.66 | 6.31 | 12.85 | 5.99 | 0.98 | 448. |
| 19.000 | 7.55 | 6.83 | 0.1641 | -3.65 | 5.40 | 10.51 | 5.46 | 1.24 | 441. |
| 20.000 | 5.26 | 6.86 | 0.1771 | -3.45 | 4.72 | 8.93 | 4.89 | 1.42 | 435. |
| 21.000 | 3.80 | 7.33 | 0.1193 | -3.51 | 4.69 | 8.58 | 4.91 | 1.31 | 428. |
| 22.000 | 2.70 | 7.91 | 0.0961 | -3.66 | 4.55 | 8.69 | 4.94 | 1.33 | 425. |
| 23.000 | 1.84 | 9.07 | 0.1191 | -3.76 | 4.61 | 9.48 | 5.56 | 1.37 | 412. |
| 24.000 | 1.81 | 10.31 | 0.1840 | -3.62 | 5.18 | 10.41 | 6.40 | 1.14 | 403. |
| 25.000 | 3.04 | 12.09 | 0.2422 | -3.64 | 5.76 | 12.07 | 7.48 | 1.26 | 389. |
| 26.000 | 4.03 | 13.74 | 0.2093 | -3.82 | 6.32 | 13.82 | 8.25 | 0.93 | 374. |
| 27.000 | 5.76 | 15.74 | 0.2392 | -3.90 | 6.93 | 15.89 | 9.53 | 0.82 | 346. |
| 28.000 | 7.84 | 17.70 | 0.2725 | -3.69 | 7.24 | 17.98 | 10.80 | 0.72 | 305. |
| 29.000 | 10.03 | 19.72 | 0.2670 | -3.48 | 8.44 | 20.36 | 12.54 | 0.78 | 252. |
| 30.000 | 12.28 | 21.97 | 0.3624 | -2.89 | 10.15 | 23.11 | 14.46 | 1.11 | 185. |

## TABLE A-13. Annual Statistical Wind Data, Nellis.

| Z KM | MEAN U M/S | S.D. U M/S | R(U,V) | MEAN V M/S | S.D. V M/S | MEAN W M/S | S.D. W M/S | SKEW W | #OBS |
|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.000 | 0.00 | 0.00 | 0.0000 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0. |
| 1.007 | 0.13 | 3.19 | -0.0093 | 0.89 | 3.88 | 4.25 | 2.82 | 0.86 | 6386. |
| 2.000 | 1.21 | 4.06 | -0.1185 | 2.46 | 6.19 | 6.74 | 4.06 | 0.95 | 6799. |
| 3.000 | 2.52 | 5.25 | -0.1050 | 1.57 | 7.16 | 7.97 | 4.88 | 1.01 | 6777. |
| 4.000 | 4.45 | 6.91 | -0.0429 | 0.54 | 8.17 | 9.85 | 6.11 | 1.05 | 6710. |
| 5.000 | 6.74 | 8.51 | 0.0115 | -0.14 | 9.58 | 12.28 | 7.67 | 1.05 | 6595. |
| 6.000 | 8.77 | 9.91 | 0.0343 | -0.43 | 11.00 | 14.59 | 9.13 | 1.07 | 6488. |
| 7.000 | 10.73 | 11.23 | 0.0327 | -0.43 | 12.57 | 17.04 | 10.45 | 1.00 | 6103. |
| 8.000 | 12.48 | 12.38 | 0.0336 | -0.47 | 13.97 | 19.32 | 11.45 | 0.88 | 6028. |
| 9.000 | 14.15 | 13.41 | 0.0319 | -0.46 | 15.25 | 21.54 | 12.20 | 0.73 | 5976. |
| 10.000 | 15.97 | 14.25 | 0.0250 | -0.36 | 16.06 | 23.57 | 12.63 | 0.63 | 5923. |
| 11.000 | 17.58 | 14.37 | 0.0110 | -0.14 | 16.13 | 24.84 | 12.60 | 0.58 | 5861. |
| 12.000 | 18.54 | 13.47 | -0.0398 | 0.44 | 15.07 | 24.78 | 11.76 | 0.48 | 5814. |
| 13.000 | 18.56 | 12.17 | -0.1035 | 0.91 | 13.46 | 23.63 | 10.77 | 0.48 | 5773. |
| 14.000 | 17.28 | 10.58 | -0.1351 | 0.95 | 11.51 | 21.28 | 9.54 | 0.50 | 5750. |
| 15.000 | 14.99 | 9.26 | -0.1336 | 0.79 | 9.62 | 18.24 | 8.41 | 0.60 | 5722. |
| 16.000 | 11.96 | 8.32 | -0.1018 | 0.55 | 7.81 | 14.67 | 7.60 | 0.79 | 5699. |
| 17.000 | 9.27 | 7.69 | -0.0474 | 0.26 | 6.49 | 11.82 | 6.84 | 1.06 | 5315. |
| 18.000 | 6.47 | 7.19 | 0.0051 | -0.03 | 5.35 | 9.17 | 6.05 | 1.47 | 5314. |
| 19.000 | 3.86 | 6.95 | 0.0538 | -0.44 | 4.52 | 7.41 | 5.22 | 1.85 | 5260. |
| 20.000 | 1.72 | 6.78 | 0.0480 | -0.73 | 3.86 | 6.56 | 4.36 | 2.11 | 5235. |
| 21.000 | 0.08 | 6.90 | 0.0032 | -0.94 | 3.54 | 6.46 | 4.14 | 1.75 | 5185. |
| 22.000 | -0.96 | 7.17 | -0.0442 | -1.09 | 3.34 | 6.80 | 4.01 | 1.54 | 5115. |
| 23.000 | -1.81 | 7.68 | -0.0850 | -1.19 | 3.30 | 7.42 | 4.26 | 1.23 | 5052. |
| 24.000 | -2.26 | 8.55 | -0.0885 | -1.15 | 3.44 | 8.13 | 4.93 | 1.08 | 4936. |
| 25.000 | -2.20 | 9.51 | -0.0696 | -1.11 | 3.69 | 8.92 | 5.44 | 1.17 | 4750. |
| 26.000 | -2.08 | 10.61 | -0.0551 | -1.12 | 3.98 | 9.83 | 6.09 | 1.15 | 4583. |
| 27.000 | -1.68 | 11.97 | -0.0343 | -1.07 | 4.36 | 10.90 | 6.87 | 1.18 | 4224. |
| 28.000 | -1.22 | 13.20 | -0.0183 | -0.92 | 4.62 | 11.82 | 7.57 | 1.32 | 3846. |
| 29.000 | -0.94 | 14.47 | -0.0104 | -0.79 | 4.93 | 12.81 | 8.41 | 1.56 | 3277. |
| 30.000 | -0.75 | 15.75 | -0.0058 | -0.65 | 5.31 | 13.82 | 9.27 | 1.77 | 2704. |

# APPENDIX B

## Nellis Thermodynamics Statistics Tables

Tables B-1 through B-13 provide thermodynamics statistics (monthly and annual) for Nellis. They were prepared as described in Chapter 3.

## TABLE B-1. January Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1019.691 | 8.241 | -0.1298 | 284.18 | 9.83 | 0.15 | 1248.59 | 50.18 | 0.05 | 392. | 392. | 392. |
| 1.000 | 903.834 | 5.924 | -0.3673 | 280.91 | 6.08 | 0.15 | 1119.16 | 25.75 | 0.10 | 482. | 482. | 482. |
| 1.007 | 903.056 | 5.914 | -0.3690 | 280.88 | 6.07 | 0.15 | 1118.34 | 25.64 | 0.10 | 482. | 482. | 482. |
| 2.000 | 799.566 | 5.699 | -0.5330 | 276.11 | 4.92 | -0.29 | 1007.50 | 16.06 | 0.61 | 483. | 483. | 483. |
| 3.000 | 705.984 | 6.026 | -0.5330 | 271.24 | 5.37 | -0.54 | 906.02 | 13.17 | 0.64 | 483. | 483. | 483. |
| 4.000 | 621.374 | 6.642 | -0.5702 | 265.66 | 5.47 | -0.77 | 814.44 | 10.39 | 0.86 | 483. | 483. | 483. |
| 5.000 | 545.595 | 7.131 | -0.6268 | 259.23 | 5.51 | -0.87 | 733.01 | 8.21 | 0.75 | 482. | 482. | 482. |
| 6.000 | 477.632 | 7.632 | -0.6827 | 252.30 | 5.58 | -0.95 | 659.40 | 6.58 | 0.51 | 480. | 480. | 480. |
| 7.000 | 416.314 | 7.722 | -0.7420 | 245.08 | 5.30 | -0.80 | 591.72 | 5.18 | 0.12 | 478. | 478. | 478. |
| 8.000 | 361.298 | 7.670 | -0.7334 | 237.66 | 4.70 | -0.51 | 529.57 | 5.56 | -0.90 | 475. | 475. | 475. |
| 9.000 | 312.311 | 7.351 | -0.6418 | 230.30 | 4.08 | -0.23 | 472.41 | 7.15 | -1.72 | 473. | 473. | 473. |
| 10.000 | 268.622 | 6.724 | -0.5030 | 223.56 | 3.60 | 0.03 | 418.62 | 9.77 | -1.66 | 473. | 473. | 473. |
| 11.000 | 230.211 | 5.862 | -0.3510 | 218.60 | 4.36 | 0.90 | 367.04 | 12.55 | -1.12 | 467. | 467. | 467. |
| 12.000 | 196.800 | 4.811 | -0.2344 | 216.65 | 5.62 | 0.45 | 316.74 | 13.40 | -0.32 | 465. | 465. | 465. |
| 13.000 | 168.048 | 3.815 | -0.1755 | 216.54 | 5.24 | -0.41 | 270.58 | 10.76 | 0.12 | 465. | 465. | 465. |
| 14.000 | 143.484 | 3.082 | -0.1200 | 215.75 | 3.97 | -0.16 | 231.81 | 7.86 | -0.06 | 464. | 464. | 464. |
| 15.000 | 122.296 | 2.432 | -0.1284 | 213.53 | 3.64 | 0.25 | 199.62 | 6.43 | -0.13 | 462. | 462. | 462. |
| 16.000 | 104.184 | 1.912 | -0.1391 | 211.25 | 3.88 | 0.24 | 171.89 | 5.58 | -0.13 | 462. | 462. | 462. |
| 17.000 | 88.546 | 1.489 | -0.1905 | 210.08 | 3.82 | 0.09 | 146.89 | 4.37 | -0.04 | 437. | 437. | 437. |
| 18.000 | 75.262 | 1.184 | -0.2115 | 209.90 | 3.85 | -0.15 | 124.96 | 3.34 | -0.01 | 434. | 434. | 434. |
| 19.000 | 64.000 | 0.999 | -0.2810 | 210.63 | 3.81 | -0.36 | 105.88 | 2.46 | 0.06 | 427. | 427. | 427. |
| 20.000 | 54.437 | 0.880 | -0.3157 | 211.53 | 3.82 | -0.41 | 89.67 | 1.75 | -0.07 | 424. | 424. | 424. |
| 21.000 | 46.358 | 0.806 | -0.3953 | 212.45 | 3.89 | -0.48 | 76.03 | 1.25 | 0.07 | 414. | 414. | 414. |
| 22.000 | 39.507 | 0.764 | -0.4752 | 213.51 | 4.11 | -0.37 | 64.46 | 1.00 | -0.04 | 406. | 406. | 406. |
| 23.000 | 33.667 | 0.729 | -0.5012 | 214.51 | 4.18 | -0.42 | 54.68 | 0.83 | -0.04 | 400. | 400. | 400. |
| 24.000 | 28.740 | 0.674 | -0.4819 | 215.55 | 4.22 | -0.45 | 46.45 | 0.73 | -0.11 | 384. | 384. | 384. |
| 25.000 | 24.537 | 0.629 | -0.4476 | 216.50 | 4.32 | -0.58 | 39.48 | 0.70 | -0.35 | 379. | 379. | 379. |
| 26.000 | 20.976 | 0.574 | -0.4175 | 217.74 | 4.28 | -0.47 | 33.56 | 0.67 | -0.82 | 368. | 368. | 368. |
| 27.000 | 17.961 | 0.520 | -0.4424 | 218.91 | 4.26 | -0.57 | 28.58 | 0.63 | -0.63 | 338. | 338. | 338. |
| 28.000 | 15.394 | 0.467 | -0.4314 | 220.15 | 4.47 | -0.36 | 24.36 | 0.61 | -0.70 | 301. | 301. | 301. |
| 29.000 | 13.225 | 0.405 | -0.3577 | 221.49 | 4.69 | -0.45 | 20.80 | 0.56 | -0.79 | 247. | 247. | 247. |
| 30.000 | 11.376 | 0.365 | -0.4344 | 223.31 | 5.07 | -0.53 | 17.75 | 0.53 | -0.79 | 209. | 209. | 209. |

## TABLE B-2. February Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1018.323 | 7.840 | -0.2329 | 284.45 | 10.21 | 0.28 | 1245.64 | 51.86 | -0.05 | 325. | 325. | 325. |
| 1.000 | 902.521 | 5.199 | -0.2884 | 282.35 | 6.84 | 0.10 | 1111.99 | 28.30 | 0.12 | 446. | 446. | 446. |
| 1.007 | 901.751 | 5.188 | -0.2853 | 282.31 | 6.81 | 0.10 | 1111.19 | 28.18 | 0.12 | 446. | 446. | 446. |
| 2.000 | 798.693 | 5.126 | -0.2904 | 276.75 | 5.01 | -0.25 | 1004.15 | 16.01 | 0.38 | 446. | 446. | 446. |
| 3.000 | 705.351 | 5.589 | -0.2965 | 271.12 | 5.12 | -0.46 | 905.62 | 12.52 | 0.56 | 446. | 446. | 446. |
| 4.000 | 620.710 | 6.188 | -0.3568 | 265.31 | 5.02 | -0.65 | 814.65 | 9.56 | 0.66 | 446. | 446. | 446. |
| 5.000 | 544.921 | 6.648 | -0.3953 | 258.73 | 5.04 | -0.54 | 733.49 | 7.66 | 0.28 | 445. | 445. | 445. |
| 6.000 | 476.899 | 7.036 | -0.4219 | 251.58 | 5.12 | -0.52 | 660.25 | 6.28 | 0.07 | 443. | 443. | 443. |
| 7.000 | 415.517 | 7.093 | -0.4542 | 244.16 | 5.00 | -0.40 | 592.79 | 5.06 | -0.25 | 441. | 441. | 441. |
| 8.000 | 360.419 | 7.135 | -0.4583 | 236.50 | 4.72 | -0.15 | 530.87 | 4.58 | -0.89 | 440. | 440. | 440. |
| 9.000 | 311.321 | 6.925 | -0.3528 | 229.05 | 4.25 | -0.02 | 473.49 | 6.02 | -1.54 | 439. | 439. | 439. |
| 10.000 | 267.536 | 6.424 | -0.2319 | 222.27 | 3.77 | 0.38 | 419.36 | 8.70 | -1.52 | 438. | 438. | 438. |
| 11.000 | 229.030 | 5.637 | -0.0874 | 217.01 | 4.41 | 0.99 | 367.82 | 11.88 | -0.97 | 437. | 437. | 437. |
| 12.000 | 195.597 | 4.670 | 0.0542 | 215.45 | 5.82 | 0.27 | 316.58 | 13.26 | -0.18 | 435. | 435. | 435. |
| 13.000 | 166.925 | 3.729 | 0.1346 | 216.27 | 5.20 | -0.69 | 269.10 | 10.49 | 0.47 | 431. | 431. | 431. |
| 14.000 | 142.517 | 3.012 | 0.1758 | 215.85 | 3.96 | -0.50 | 230.13 | 7.70 | 0.36 | 428. | 428. | 428. |
| 15.000 | 121.512 | 2.386 | 0.1415 | 214.03 | 3.53 | -0.26 | 197.87 | 6.36 | 0.36 | 427. | 427. | 427. |
| 16.000 | 103.565 | 1.870 | 0.0884 | 212.21 | 3.77 | -0.24 | 170.10 | 5.38 | 0.36 | 426. | 426. | 426. |
| 17.000 | 88.119 | 1.466 | 0.0040 | 210.96 | 4.10 | -0.34 | 145.59 | 4.53 | 0.43 | 410. | 410. | 410. |
| 18.000 | 74.932 | 1.156 | -0.1232 | 210.67 | 4.05 | -0.32 | 123.96 | 3.49 | 0.43 | 407. | 407. | 407. |
| 19.000 | 63.765 | 0.935 | -0.2737 | 211.49 | 3.76 | -0.33 | 105.07 | 2.46 | 0.50 | 394. | 394. | 394. |
| 20.000 | 54.269 | 0.804 | -0.4712 | 212.41 | 3.46 | -0.30 | 89.03 | 1.74 | 0.33 | 392. | 392. | 392. |
| 21.000 | 46.238 | 0.722 | -0.5834 | 213.40 | 3.29 | -0.18 | 75.49 | 1.26 | 0.07 | 383. | 383. | 383. |
| 22.000 | 39.443 | 0.643 | -0.5785 | 214.57 | 3.24 | -0.20 | 64.04 | 0.95 | -0.02 | 372. | 372. | 372. |
| 23.000 | 33.654 | 0.595 | -0.6019 | 215.68 | 3.03 | -0.28 | 54.36 | 0.74 | -0.34 | 366. | 366. | 366. |
| 24.000 | 28.747 | 0.540 | -0.5864 | 216.84 | 2.99 | -0.25 | 46.19 | 0.64 | -0.31 | 354. | 354. | 354. |
| 25.000 | 24.578 | 0.499 | -0.5895 | 217.94 | 2.95 | -0.43 | 39.29 | 0.60 | -0.68 | 349. | 349. | 349. |
| 26.000 | 21.030 | 0.441 | -0.4045 | 219.26 | 2.87 | -0.47 | 33.42 | 0.54 | -0.73 | 342. | 342. | 342. |
| 27.000 | 18.023 | 0.376 | -0.5744 | 220.45 | 2.96 | -0.84 | 28.48 | 0.49 | -1.09 | 301. | 301. | 301. |
| 28.000 | 15.461 | 0.339 | -0.4751 | 221.61 | 3.20 | -0.68 | 24.31 | 0.45 | -1.33 | 269. | 269. | 269. |
| 29.000 | 13.276 | 0.307 | -0.3736 | 222.91 | 3.22 | -0.23 | 20.75 | 0.41 | -1.41 | 227. | 227. | 227. |
| 30.000 | 11.395 | 0.272 | -0.2946 | 224.26 | 3.31 | 0.18 | 17.70 | 0.37 | -0.86 | 187. | 187. | 187. |

## TABLE B-3. March Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1014.100 | 7.491 | -0.1777 | 285.34 | 7.60 | 0.83 | 1235.32 | 38.51 | -0.45 | 297. | 297. | 297. |
| 1.000 | 899.600 | 5.368 | -0.3222 | 284.54 | 6.46 | 0.29 | 1099.51 | 25.13 | -0.06 | 491. | 491. | 491. |
| 1.007 | 898.829 | 5.363 | -0.3281 | 284.51 | 6.39 | 0.32 | 1098.69 | 24.90 | -0.08 | 491. | 491. | 491. |
| 2.000 | 796.508 | 5.381 | -0.3963 | 277.66 | 4.43 | 0.31 | 997.85 | 13.29 | -0.21 | 491. | 491. | 491. |
| 3.000 | 703.595 | 5.620 | -0.3078 | 270.34 | 4.27 | 0.11 | 905.66 | 10.47 | 0.06 | 491. | 491. | 491. |
| 4.000 | 618.920 | 6.020 | -0.2529 | 264.09 | 4.46 | -0.22 | 815.97 | 8.88 | 0.29 | 490. | 490. | 490. |
| 5.000 | 543.007 | 6.255 | -0.2103 | 257.54 | 4.66 | -0.35 | 734.30 | 7.62 | 0.23 | 490. | 490. | 490. |
| 6.000 | 474.852 | 6.552 | -0.2258 | 250.48 | 4.66 | -0.44 | 660.32 | 6.20 | -0.07 | 489. | 489. | 489. |
| 7.000 | 413.496 | 6.564 | -0.2544 | 242.99 | 4.64 | -0.40 | 592.76 | 5.44 | -0.44 | 486. | 486. | 486. |
| 8.000 | 358.447 | 6.578 | -0.2861 | 235.50 | 4.37 | -0.35 | 530.23 | 5.37 | -0.79 | 486. | 486. | 486. |
| 9.000 | 309.476 | 6.323 | -0.2099 | 228.30 | 3.79 | -0.17 | 472.24 | 6.50 | -1.34 | 483. | 483. | 483. |
| 10.000 | 265.878 | 5.731 | -0.1293 | 222.14 | 3.26 | 0.22 | 417.00 | 9.15 | -1.17 | 479. | 479. | 479. |
| 11.000 | 227.673 | 4.893 | 0.0129 | 217.90 | 4.26 | 0.68 | 364.18 | 12.01 | -0.66 | 477. | 477. | 477. |
| 12.000 | 194.582 | 3.915 | 0.1181 | 216.77 | 5.76 | -0.02 | 313.02 | 12.72 | 0.11 | 475. | 475. | 475. |
| 13.000 | 166.197 | 3.012 | 0.1520 | 217.08 | 5.33 | -0.60 | 266.93 | 9.89 | 0.50 | 475. | 475. | 475. |
| 14.000 | 141.978 | 2.386 | 0.1892 | 216.69 | 3.92 | -0.54 | 228.36 | 6.70 | 0.27 | 471. | 471. | 471. |
| 15.000 | 121.143 | 1.868 | 0.1912 | 215.03 | 3.46 | -0.16 | 196.34 | 5.37 | 0.15 | 470. | 470. | 470. |
| 16.000 | 103.329 | 1.451 | 0.2084 | 213.24 | 3.58 | -0.04 | 168.87 | 4.58 | 0.21 | 469. | 469. | 469. |
| 17.000 | 88.029 | 1.132 | 0.2004 | 212.33 | 3.77 | 0.00 | 144.49 | 3.80 | 0.27 | 441. | 441. | 441. |
| 18.000 | 74.936 | 0.877 | 0.1844 | 211.99 | 3.54 | -0.19 | 123.19 | 2.92 | 0.25 | 439. | 439. | 439. |
| 19.000 | 63.823 | 0.715 | 0.1664 | 212.48 | 3.00 | 0.08 | 104.66 | 2.01 | -0.02 | 431. | 431. | 431. |
| 20.000 | 54.360 | 0.602 | 0.2329 | 213.13 | 2.76 | 0.08 | 88.87 | 1.43 | 0.15 | 429. | 429. | 429. |
| 21.000 | 46.345 | 0.526 | 0.2445 | 213.89 | 2.57 | -0.06 | 75.49 | 1.07 | 0.15 | 419. | 419. | 419. |
| 22.000 | 39.527 | 0.473 | 0.2945 | 214.60 | 2.49 | -0.02 | 64.18 | 0.81 | 0.24 | 409. | 409. | 409. |
| 23.000 | 33.719 | 0.436 | 0.3349 | 215.61 | 2.43 | 0.01 | 54.49 | 0.64 | 0.02 | 403. | 403. | 403. |
| 24.000 | 28.790 | 0.401 | 0.3629 | 216.63 | 2.48 | -0.19 | 46.30 | 0.57 | -0.07 | 386. | 386. | 386. |
| 25.000 | 24.611 | 0.371 | 0.2718 | 217.73 | 2.69 | -0.17 | 39.38 | 0.50 | -0.27 | 377. | 377. | 377. |
| 26.000 | 21.053 | 0.335 | 0.3600 | 219.15 | 2.64 | 0.13 | 33.47 | 0.45 | -0.41 | 366. | 366. | 366. |
| 27.000 | 18.054 | 0.304 | 0.3056 | 220.67 | 2.85 | 0.09 | 28.50 | 0.41 | -0.34 | 324. | 324. | 324. |
| 28.000 | 15.484 | 0.281 | 0.2617 | 222.23 | 3.19 | 0.59 | 24.27 | 0.38 | -0.26 | 296. | 296. | 296. |
| 29.000 | 13.294 | 0.255 | 0.4288 | 223.96 | 3.54 | 0.63 | 20.68 | 0.35 | -0.29 | 245. | 245. | 245. |
| 30.000 | 11.407 | 0.245 | 0.4008 | 225.76 | 3.74 | 0.35 | 17.60 | 0.33 | -0.17 | 203. | 203. | 203. |

## TABLE B-4. April Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1012.319 | 6.436 | 0.0674 | 289.15 | 8.51 | 0.85 | 1217.49 | 40.65 | -0.56 | 288. | 288. | 288. |
| 1.000 | 899.086 | 4.358 | 0.1735 | 288.75 | 7.27 | 0.22 | 1083.29 | 27.89 | -0.07 | 477. | 477. | 477. |
| 1.007 | 898.333 | 4.348 | 0.1739 | 288.71 | 7.24 | 0.21 | 1082.52 | 27.82 | -0.06 | 477. | 477. | 477. |
| 2.000 | 797.344 | 4.411 | -0.1660 | 281.70 | 5.38 | -0.18 | 984.83 | 16.75 | 0.20 | 477. | 477. | 477. |
| 3.000 | 705.540 | 4.925 | -0.3405 | 273.68 | 5.05 | -0.42 | 897.19 | 12.81 | 0.42 | 476. | 476. | 476. |
| 4.000 | 621.550 | 5.552 | -0.4586 | 266.86 | 5.04 | -0.85 | 810.94 | 10.20 | 0.90 | 476. | 476. | 476. |
| 5.000 | 546.081 | 6.054 | -0.5958 | 260.41 | 5.08 | -1.11 | 730.35 | 8.16 | 1.03 | 476. | 476. | 476. |
| 6.000 | 478.270 | 6.553 | -0.7144 | 253.31 | 5.19 | -1.24 | 657.67 | 6.71 | 0.87 | 475. | 475. | 475. |
| 7.000 | 417.092 | 6.695 | -0.8522 | 246.03 | 5.01 | -1.31 | 590.55 | 5.47 | 0.60 | 475. | 475. | 475. |
| 8.000 | 362.246 | 6.674 | -0.9042 | 238.64 | 4.35 | -1.08 | 528.78 | 5.04 | -0.49 | 472. | 472. | 472. |
| 9.000 | 313.381 | 6.415 | -0.8775 | 231.33 | 3.49 | -0.59 | 471.93 | 6.50 | -1.44 | 472. | 472. | 472. |
| 10.000 | 269.679 | 5.838 | -0.7399 | 224.41 | 2.97 | 0.05 | 418.67 | 8.82 | -1.74 | 469. | 469. | 469. |
| 11.000 | 231.161 | 5.036 | -0.5509 | 218.41 | 3.53 | 1.04 | 368.82 | 10.78 | -1.48 | 467. | 467. | 467. |
| 12.000 | 197.497 | 4.108 | -0.3871 | 214.75 | 4.88 | 0.75 | 320.61 | 11.94 | -0.78 | 464. | 464. | 464. |
| 13.000 | 168.384 | 3.176 | -0.2819 | 214.52 | 5.32 | -0 05 | 273.68 | 10.52 | -0.08 | 463. | 463. | 463. |
| 14.000 | 143.615 | 2.471 | -0.2280 | 214.71 | 4.03 | -0.26 | 233.13 | 7.32 | 0.02 | 462. | 462. | 462. |
| 15.000 | 122.409 | 1.917 | -0.2113 | 213.69 | 3.41 | 0.30 | 199.64 | 5.51 | -0.27 | 459. | 459. | 459. |
| 16.000 | 104.314 | 1.500 | -0.1423 | 212.71 | 3.34 | 0.43 | 170.90 | 4.44 | -0.31 | 459. | 459. | 459. |
| 17.000 | 88.819 | 1.188 | -0.0739 | 212.26 | 3.37 | 0.23 | 145.82 | 3.51 | -0.21 | 425. | 425. | 425. |
| 18.000 | 75.612 | 0.955 | 0.0276 | 212.41 | 3.27 | -0.07 | 124.05 | 2.73 | -0.11 | 425. | 425. | 425. |
| 19.000 | 64.422 | 0.789 | 0.0796 | 213.16 | 3.20 | 0.08 | 105.31 | 2.12 | -0.15 | 418. | 418. | 418. |
| 20.000 | 54.898 | 0.677 | 0.1007 | 213.89 | 2.82 | 0.15 | 89.42 | 1.53 | -0.13 | 417. | 417. | 417. |
| 21.000 | 46.827 | 0.598 | 0.1047 | 214.79 | 2.55 | 0.07 | 75.96 | 1.12 | 0.00 | 410. | 410. | 410. |
| 22.000 | 39.979 | 0.538 | 0.1006 | 215.97 | 2.40 | -0.02 | 64.49 | 0.87 | -0.08 | 401. | 401. | 401. |
| 23.000 | 34.144 | 0.487 | 0.0650 | 217.31 | 2.33 | -0.07 | 54.74 | 0.71 | -0.18 | 397. | 397. | 397. |
| 24.000 | 29.180 | 0.445 | 0.0818 | 218.51 | 2.27 | -0.04 | 46.52 | 0.58 | -0.29 | 386. | 386. | 386. |
| 25.000 | 24.979 | 0.401 | 0.0223 | 220.11 | 2.40 | -0.07 | 39.54 | 0.53 | -0.44 | 376. | 376. | 376. |
| 26.000 | 21.388 | 0.367 | -0.0137 | 221.77 | 2.73 | 0.25 | 33.60 | 0.49 | -0.37 | 367. | 367. | 367. |
| 27.000 | 18.356 | 0.338 | -0.0019 | 223.42 | 2.85 | 0.17 | 28.63 | 0.44 | -0.27 | 324. | 324. | 324. |
| 28.000 | 15.778 | 0.315 | -0.0480 | 225.13 | 3.02 | 0.32 | 24.41 | 0.40 | -0.25 | 300. | 300. | 300. |
| 29.000 | 13.571 | 0.285 | -0.0368 | 227.02 | 3.19 | 0.20 | 20.82 | 0.35 | -0.26 | 262. | 262. | 262. |
| 30.000 | 11.660 | 0.252 | -0.1234 | 228.83 | 3.07 | 0.03 | 17.75 | 0.31 | -0.17 | 224. | 224. | 224. |

## TABLE B-5. May Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1008.083 | 5.737 | 0.0071 | 295.67 | 10.00 | 0.88 | 1185.58 | 43.98 | -0.61 | 306. | 306. | 306. |
| 1.000 | 897.438 | 3.575 | -0.0254 | 294.35 | 7.72 | 0.14 | 1060.34 | 28.35 | -0.01 | 473. | 473. | 473. |
| 1.007 | 896.712 | 3.568 | -0.0337 | 294.30 | 7.69 | 0.14 | 1059.67 | 28.26 | -0.01 | 473. | 473. | 473. |
| 2.000 | 797.708 | 3.759 | -0.4485 | 287.22 | 5.46 | -0.30 | 965.93 | 16.54 | 0.32 | 473. | 473. | 473. |
| 3.000 | 707.523 | 4.366 | -0.5766 | 278.73 | 5.07 | -0.35 | 883.04 | 12.40 | 0.32 | 473. | 473. | 473. |
| 4.000 | 624.681 | 5.034 | -0.5947 | 271.11 | 4.72 | -0.56 | 801.91 | 9.35 | 0.46 | 473. | 473. | 473. |
| 5.000 | 549.951 | 5.468 | -0.6398 | 264.34 | 4.46 | -0.84 | 724.37 | 7.16 | 0.56 | 473. | 473. | 473. |
| 6.000 | 482.728 | 5.871 | -0.6850 | 257.39 | 4.54 | -1.02 | 653.17 | 5.91 | 0.26 | 472. | 472. | 472. |
| 7.000 | 421.888 | 5.931 | -0.7753 | 250.16 | 4.58 | -1.00 | 587.44 | 5.07 | -0.26 | 469. | 469. | 469. |
| 8.000 | 367.152 | 5.983 | -0.7705 | 242.59 | 4.24 | -0.71 | 527.21 | 4.41 | -0.95 | 469. | 469. | 469. |
| 9.000 | 318.325 | 5.771 | -0.7678 | 234.90 | 3.73 | -0.46 | 472.08 | 4.98 | -2.26 | 468. | 468. | 468. |
| 10.000 | 274.645 | 5.522 | -0.5282 | 227.55 | 3.29 | -0.13 | 420.48 | 6.55 | -2.71 | 468. | 468. | 468. |
| 11.000 | 235.883 | 4.972 | -0.3166 | 221.04 | 3.14 | 0.46 | 371.80 | 8.47 | -1.94 | 465. | 465. | 465. |
| 12.000 | 201.796 | 4.201 | -0.1178 | 216.31 | 4.07 | 0.80 | 325.15 | 10.19 | -1.07 | 464. | 464. | 464. |
| 13.000 | 172.172 | 3.371 | 0.0218 | 214.39 | 4.96 | 0.25 | 279.98 | 10.34 | -0.23 | 462. | 462. | 462. |
| 14.000 | 146.833 | 2.599 | 0.0650 | 214.21 | 4.72 | -0.42 | 238.96 | 8.44 | 0.37 | 461. | 461. | 461. |
| 15.000 | 125.105 | 1.997 | 0.0364 | 213.61 | 3.79 | -0.37 | 204.12 | 6.02 | 0.30 | 459. | 459. | 459. |
| 16.000 | 106.589 | 1.559 | 0.0423 | 212.48 | 3.49 | -0.25 | 174.82 | 4.64 | 0.16 | 459. | 459. | 459. |
| 17.000 | 90.798 | 1.225 | 0.0782 | 211.92 | 3.42 | -0.03 | 149.31 | 3.69 | 0.04 | 428. | 428. | 428. |
| 18.000 | 77.282 | 0.972 | 0.0893 | 211.97 | 3.27 | 0.04 | 127.05 | 2.92 | 0.08 | 427. | 427. | 427. |
| 19.000 | 65.809 | 0.788 | 0.0329 | 212.78 | 2.84 | -0.05 | 107.77 | 2.10 | 0.14 | 422. | 422. | 422. |
| 20.000 | 56.082 | 0.669 | 0.0601 | 214.07 | 2.59 | 0.01 | 91.28 | 1.48 | 0.10 | 420. | 420. | 420. |
| 21.000 | 47.846 | 0.580 | 0.0579 | 215.75 | 2.36 | -0.04 | 77.26 | 1.02 | 0.05 | 415. | 415. | 415. |
| 22.000 | 40.898 | 0.529 | 0.0623 | 217.39 | 2.25 | -0.19 | 65.54 | 0.76 | -0.08 | 413. | 413. | 413. |
| 23.000 | 34.967 | 0.489 | 0.0724 | 219.11 | 2.17 | -0.29 | 55.60 | 0.58 | -0.11 | 411. | 411. | 411. |
| 24.000 | 29.916 | 0.448 | 0.0678 | 220.86 | 2.24 | -0.29 | 47.19 | 0.49 | 0.02 | 400. | 400. | 400. |
| 25.000 | 25.659 | 0.409 | 0.0098 | 222.55 | 2.25 | -0.27 | 40.16 | 0.42 | -0.05 | 383. | 383. | 383. |
| 26.000 | 22.014 | 0.379 | -0.0151 | 224.37 | 2.32 | -0.10 | 34.18 | 0.40 | -0.01 | 376. | 376. | 376. |
| 27.000 | 18.914 | 0.347 | -0.0097 | 226.17 | 2.38 | -0.24 | 29.13 | 0.38 | 0.02 | 353. | 353. | 353. |
| 28.000 | 16.278 | 0.318 | 0.0110 | 227.97 | 2.50 | -0.05 | 24.88 | 0.34 | 0.07 | 321. | 321. | 321. |
| 29.000 | 14.020 | 0.292 | -0.0448 | 229.78 | 2.56 | 0.07 | 21.25 | 0.32 | 0.04 | 300. | 300. | 300. |
| 30.000 | 12.076 | 0.264 | -0.0133 | 231.59 | 2.50 | 0.26 | 18.16 | 0.28 | 0.04 | 259. | 259. | 259. |

## TABLE B-6. June Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1006.684 | 5.474 | 0.0373 | 301.31 | 10.91 | 0.64 | 1162.43 | 46.21 | -0.44 | 356. | 356. | 356. |
| 1.000 | 898.198 | 3.247 | -0.1289 | 299.66 | 7.52 | 0.07 | 1042.22 | 27.11 | 0.02 | 516. | 516. | 516. |
| 1.007 | 897.324 | 3.140 | -0.1348 | 299.59 | 7.48 | 0.07 | 1041.42 | 26.97 | 0.02 | 516. | 516. | 516. |
| 2.000 | 800.145 | 3.326 | -0.5405 | 292.75 | 4.43 | -0.48 | 950.14 | 13.13 | 0.49 | 528. | 528. | 528. |
| 3.000 | 711.302 | 3.727 | -0.6085 | 284.22 | 4.02 | -0.43 | 870.39 | 9.71 | 0.43 | 528. | 528. | 528. |
| 4.000 | 629.473 | 4.083 | -0.6595 | 276.41 | 3.70 | -0.57 | 792.38 | 7.50 | 0.43 | 528. | 528. | 528. |
| 5.000 | 555.493 | 4.370 | -0.6175 | 269.23 | 3.47 | -0.83 | 718.22 | 5.93 | 0.66 | 528. | 528. | 528. |
| 6.000 | 488.964 | 4.646 | [illegible] | 262.25 | 3.30 | -0.89 | 649.23 | 4.71 | -0.05 | 527. | 527. | 527. |
| 7.000 | 428.287 | 4.591 | [illegible] | 255.02 | 3.25 | -0.80 | 584.90 | 4.18 | -0.46 | 526. | 526. | 526. |
| 8.000 | 373.794 | 4.636 | [illegible] | 247.47 | 3.21 | -0.62 | 526.10 | 3.66 | -0.53 | 524. | 524. | 524. |
| 9.000 | 324.854 | 4.441 | [illegible] | 239.78 | 3.14 | -0.45 | 471.93 | 3.59 | -0.78 | 523. | 523. | 523. |
| 10.000 | 281.311 | 4.385 | -0.5840 | 232.26 | 2.96 | -0.42 | 421.94 | 3.92 | -1.64 | 522. | 522. | 522. |
| 11.000 | 242.299 | 4.107 | -0.4935 | 225.14 | 2.85 | -0.31 | 374.93 | 4.96 | -1.75 | 518. | 518. | 518. |
| 12.000 | 207.713 | 3.634 | -0.4248 | 219.24 | 3.10 | 0.26 | 330.09 | 6.37 | -1.33 | 517. | 517. | 517. |
| 13.000 | 177.510 | 3.122 | -0.3263 | 215.51 | 3.62 | 0.20 | 287.03 | 7.57 | -0.57 | 514. | 514. | 514. |
| 14.000 | 151.412 | 2.551 | -0.2955 | 213.44 | 3.71 | -0.17 | 247.24 | 7.21 | -0.16 | 513. | 513. | 513. |
| 15.000 | 128.869 | 1.986 | -0.2933 | 211.45 | 3.72 | -0.04 | 212.41 | 6.28 | -0.09 | 512. | 512. | 512. |
| 16.000 | 109.591 | 1.505 | -0.2900 | 209.90 | 3.75 | 0.07 | 181.98 | 5.10 | -0.17 | 512. | 512. | 512. |
| 17.000 | 93.182 | 1.154 | -0.2724 | 209.14 | 3.48 | 0.29 | 155.27 | 3.83 | -0.32 | 478. | 478. | 478. |
| 18.000 | 79.175 | 0.916 | -0.1737 | 210.13 | 3.01 | 0.29 | 131.29 | 2.66 | -0.35 | 478. | 478. | 478. |
| 19.000 | 67.363 | 0.763 | -0.0519 | 212.27 | 2.48 | 0.06 | 110.56 | 1.72 | -0.40 | 476. | 476. | 476. |
| 20.000 | 57.410 | 0.671 | 0.0357 | 214.38 | 2.19 | -0.01 | 93.30 | 1.22 | -0.22 | 474. | 474. | 474. |
| 21.000 | 48.981 | 0.600 | 0.0379 | 216.31 | 1.96 | 0.06 | 78.88 | 0.89 | -0.15 | 464. | 464. | 464. |
| 22.000 | 41.889 | 0.549 | 0.0774 | 218.17 | 1.84 | -0.01 | 66.89 | 0.73 | -0.14 | 464. | 464. | 464. |
| 23.000 | 35.836 | 0.500 | 0.1126 | 219.99 | 1.82 | 0.03 | 56.74 | 0.62 | -0.02 | 457. | 457. | 457. |
| 24.000 | 30.672 | 0.454 | 0.1607 | 221.83 | 1.81 | -0.19 | 48.17 | 0.56 | 0.02 | 455. | 455. | 455. |
| 25.000 | 26.335 | 0.409 | 0.1352 | 223.77 | 1.84 | -0.18 | 40.99 | 0.49 | -0.01 | 442. | 442. | 442. |
| 26.000 | 22.616 | 0.373 | 0.1182 | 225.56 | 1.94 | -0.03 | 34.93 | 0.44 | 0.03 | 437. | 436. | 437. |
| 27.000 | 19.451 | 0.330 | 0.1253 | 227.35 | 1.91 | -0.02 | 29.80 | 0.40 | -0.03 | 409. | 409. | 409. |
| 28.000 | 16.751 | 0.296 | 0.1391 | 229.06 | 1.93 | -0.04 | 25.47 | 0.36 | -0.15 | 375. | 375. | 375. |
| 29.000 | 14.438 | 0.271 | 0.1480 | 230.78 | 2.04 | -0.20 | 21.79 | 0.32 | 0.06 | 338. | 338. | 338. |
| 30.000 | 12.453 | 0.248 | 0.1151 | 232.51 | 2.16 | -0.07 | 18.65 | 0.29 | 0.01 | 292. | 292. | 292. |

## TABLE B-7. July Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1006.989 | 4.991 | -0.2812 | 304.67 | 10.59 | 0.61 | 1147.77 | 43.93 | -0.42 | 396. | 396. | 396. |
| 1.000 | 899.885 | 2.511 | -0.0158 | 302.45 | 7.04 | 0.06 | 1033.20 | 24.78 | 0.02 | 550. | 550. | 550. |
| 1.007 | 899.120 | 2.521 | 0.0127 | 302.39 | 7.00 | 0.06 | 1032.51 | 24.64 | 0.01 | 550. | 550. | 550. |
| 2.000 | 802.661 | 2.255 | -0.5448 | 295.61 | 8.48 | -0.47 | 943.00 | 10.58 | 0.42 | 558. | 558. | 558. |
| 3.000 | 714.370 | 2.408 | -0.7024 | 287.14 | 2.92 | -0.48 | 864.42 | 7.34 | 0.44 | 558. | 558. | 558. |
| 4.000 | 633.161 | 2.689 | -0.7484 | 279.27 | 2.42 | -0.71 | 788.22 | 5.14 | 0.46 | 557. | 557. | 557. |
| 5.000 | 559.549 | 2.822 | -0.7128 | 272.09 | 2.15 | -0.70 | 715.46 | 4.12 | -0.04 | 556. | 556. | 556. |
| 6.000 | 493.227 | 2.822 | -0.8402 | 265.33 | 2.05 | -0.65 | 647.14 | 3.83 | -0.06 | 555. | 554. | 555. |
| 7.000 | 432.728 | 2.773 | -0.9996 | 258.55 | 2.24 | -0.78 | 582.86 | 3.66 | 0.21 | 553. | 552. | 553. |
| 8.000 | 378.482 | 2.794 | -1.1269 | 251.44 | 2.42 | -1.08 | 524.27 | 3.32 | 0.30 | 547. | 547. | 547. |
| 9.000 | 329.602 | 2.732 | -1.2090 | 244.04 | 2.48 | -0.62 | 470.45 | 3.20 | -0.02 | 544. | 544. | 544. |
| 10.000 | 286.251 | 2.729 | -1.2040 | 236.55 | 2.48 | -0.56 | 421.54 | 3.07 | -0.68 | 543. | 543. | 543. |
| 11.000 | 247.259 | 2.652 | -1.1073 | 229.32 | 2.43 | -0.32 | 375.64 | 3.19 | -1.51 | 542. | 542. | 542. |
| 12.000 | 212.425 | 2.418 | -1.0453 | 222.66 | 2.32 | -0.03 | 332.38 | 3.49 | -1.45 | 542. | 542. | 542. |
| 13.000 | 181.826 | 2.155 | -0.9169 | 216.72 | 2.27 | 0.17 | 292.31 | 4.39 | -1.23 | 540. | 540. | 540. |
| 14.000 | 155.089 | 1.818 | -0.7488 | 211.52 | 2.73 | 0.86 | 255.47 | 4.86 | -1.38 | 540. | 540. | 540. |
| 15.000 | 131.767 | 1.471 | -0.4805 | 207.78 | 3.14 | 1.11 | 220.98 | 4.77 | -1.19 | 539. | 539. | 539. |
| 16.000 | 111.743 | 1.147 | -0.1835 | 206.37 | 3.22 | 0.94 | 188.69 | 4.05 | -0.87 | 539. | 539. | 539. |
| 17.000 | 94.776 | 0.905 | -0.0149 | 207.22 | 2.73 | 0.63 | 159.36 | 2.76 | -0.57 | 499. | 499. | 499. |
| 18.000 | 80.447 | 0.769 | 0.0586 | 209.27 | 2.40 | 0.28 | 133.94 | 1.88 | -0.42 | 497. | 497. | 497. |
| 19.000 | 68.412 | 0.664 | 0.0984 | 212.08 | 1.93 | 0.27 | 112.38 | 1.28 | -0.18 | 497. | 497. | 497. |
| 20.000 | 58.316 | 0.605 | 0.1191 | 214.61 | 1.72 | 0.16 | 94.67 | 0.95 | -0.12 | 496. | 496. | 496. |
| 21.000 | 49.750 | 0.542 | 0.1759 | 216.76 | 1.69 | 0.16 | 79.96 | 0.75 | -0.01 | 494. | 494. | 494. |
| 22.000 | 42.569 | 0.495 | 0.1556 | 218.75 | 1.80 | 0.35 | 67.79 | 0.65 | -0.15 | 489. | 489. | 489. |
| 23.000 | 36.437 | 0.455 | 0.1747 | 220.50 | 1.70 | 0.28 | 57.57 | 0.57 | 0.01 | 485. | 485. | 485. |
| 24.000 | 31.201 | 0.417 | 0.1711 | 222.17 | 1.72 | 0.04 | 48.92 | 0.48 | 0.01 | 484. | 484. | 484. |
| 25.000 | 26.784 | 0.373 | 0.1257 | 223.91 | 1.75 | 0.04 | 41.67 | 0.42 | -0.05 | 463. | 463. | 463. |
| 26.000 | 23.008 | 0.344 | 0.1465 | 225.65 | 1.84 | 0.04 | 35.52 | 0.38 | -0.01 | 456. | 456. | 456. |
| 27.000 | 19.785 | 0.309 | 0.1142 | 227.35 | 1.99 | 0.03 | 30.31 | 0.34 | 0.04 | 433. | 433. | 433. |
| 28.000 | 17.043 | 0.286 | 0.1355 | 228.95 | 2.05 | 0.02 | 25.94 | 0.31 | 0.01 | 398. | 398. | 398. |
| 29.000 | 14.693 | 0.262 | 0.1568 | 230.59 | 2.27 | -0.26 | 22.20 | 0.30 | 0.22 | 366. | 366. | 366. |
| 30.000 | 12.665 | 0.235 | 0.1736 | 232.09 | 2.26 | -0.14 | 19.01 | 0.27 | 0.01 | 321. | 321. | 321. |

## TABLE B-8. August Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1008.026 | 5.359 | -0.1204 | 304.68 | 10.62 | 0.48 | 1148.03 | 43.74 | -0.28 | 414. | 414. | 414. |
| 1.000 | 900.706 | 3.233 | 0.1783 | 301.78 | 7.05 | 0.08 | 1035.96 | 24.90 | 0.00 | 543. | 543. | 543. |
| 1.007 | 899.442 | 2.701 | -0.1983 | 301.69 | 6.99 | 0.08 | 1034.83 | 24.67 | -0.02 | 543. | 543. | 543. |
| 2.000 | 803.212 | 2.794 | 0.2674 | 295.03 | 3.64 | -0.27 | 945.26 | 11.26 | 0.22 | 551. | 551. | 551. |
| 3.000 | 714.687 | 2.748 | 0.2722 | 286.51 | 3.08 | -0.12 | 866.51 | 8.08 | 0.13 | 551. | 551. | 551. |
| 4.000 | 633.285 | 2.921 | 0.1319 | 278.69 | 2.49 | -0.27 | 789.95 | 5.75 | 0.28 | 551. | 551. | 551. |
| 5.000 | 559.517 | 2.962 | 0.0748 | 271.63 | 2.15 | -0.43 | 716.63 | 4.31 | 0.24 | 551. | 551. | 551. |
| 6.000 | 493.126 | 2.992 | 0.0205 | 264.96 | 2.09 | -0.46 | 647.87 | 4.02 | 0.01 | 549. | 549. | 549. |
| 7.000 | 432.575 | 2.920 | -0.1854 | 258.16 | 2.23 | -0.65 | 583.50 | 3.52 | 0.23 | 546. | 546. | 546. |
| 8.000 | 378.262 | 2.944 | -0.3567 | 250.95 | 2.48 | -0.55 | 524.99 | 3.30 | 0.10 | 546. | 546. | 546. |
| 9.000 | 329.328 | 2.929 | -0.4378 | 243.47 | 2.77 | -0.37 | 471.17 | 3.07 | -0.25 | 544. | 544. | 544. |
| 10.000 | 285.864 | 2.943 | -0.5690 | 236.03 | 2.87 | -0.39 | 421.90 | 2.78 | -0.25 | 543. | 543. | 543. |
| 11.000 | 246.854 | 2.925 | -0.5633 | 228.93 | 2.86 | -0.52 | 375.65 | 2.80 | -0.58 | 543. | 543. | 543. |
| 12.000 | 212.056 | 2.733 | -0.5734 | 222.45 | 2.42 | -0.34 | 332.09 | 3.12 | -0.87 | 542. | 542. | 542. |
| 13.000 | 181.497 | 2.471 | -0.4869 | 216.78 | 2.05 | 0.37 | 291.69 | 4.42 | -1.02 | 539. | 539. | 539. |
| 14.000 | 154.840 | 2.072 | -0.3512 | 211.89 | 2.56 | 0.71 | 254.62 | 5.30 | -0.99 | 538. | 538. | 538. |
| 15.000 | 131.593 | 1.650 | -0.0878 | 208.28 | 3.36 | 0.85 | 220.18 | 5.38 | -0.81 | 534. | 534. | 534. |
| 16.000 | 111.630 | 1.265 | 0.1589 | 206.64 | 3.58 | 0.56 | 188.26 | 4.55 | -0.50 | 532. | 532. | 532. |
| 17.000 | 94.661 | 0.988 | 0.3698 | 207.57 | 3.00 | 0.44 | 158.90 | 3.09 | -0.31 | 492. | 492. | 492. |
| 18.000 | 80.381 | 0.823 | 0.4260 | 209.79 | 2.38 | 0.07 | 133.49 | 2.05 | 0.04 | 486. | 486. | 486. |
| 19.000 | 68.374 | 0.701 | 0.4319 | 212.52 | 1.98 | 0.00 | 112.09 | 1.44 | 0.03 | 483. | 483. | 483. |
| 20.000 | 58.295 | 0.617 | 0.3506 | 214.78 | 1.74 | 0.11 | 94.55 | 1.04 | 0.20 | 482. | 482. | 482. |
| 21.000 | 49.742 | 0.552 | 0.4135 | 216.79 | 1.63 | 0.07 | 79.93 | 0.82 | 0.48 | 481. | 481. | 481. |
| 22.000 | 42.557 | 0.499 | 0.4043 | 218.46 | 1.56 | 0.01 | 67.86 | 0.70 | 0.41 | 480. | 480. | 480. |
| 23.000 | 36.419 | 0.457 | 0.4611 | 220.07 | 1.54 | -0.02 | 57.65 | 0.59 | 0.64 | 476. | 476. | 476. |
| 24.000 | 31.176 | 0.417 | 0.4591 | 221.71 | 1.63 | 0.05 | 48.98 | 0.51 | 0.78 | 475. | 475. | 475. |
| 25.000 | 26.749 | 0.379 | 0.4475 | 223.28 | 1.70 | 0.10 | 41.73 | 0.44 | 1.00 | 453. | 453. | 453. |
| 26.000 | 22.968 | 0.346 | 0.4548 | 224.89 | 1.86 | 0.19 | 35.58 | 0.40 | 0.80 | 449. | 449. | 449. |
| 27.000 | 19.742 | 0.314 | 0.4332 | 226.37 | 2.01 | 0.34 | 30.37 | 0.35 | 0.80 | 422. | 422. | 422. |
| 28.000 | 16.989 | 0.287 | 0.4152 | 227.70 | 2.07 | 0.29 | 25.99 | 0.31 | 0.65 | 401. | 401. | 401. |
| 29.000 | 14.630 | 0.267 | 0.4414 | 229.01 | 2.24 | 0.13 | 22.25 | 0.28 | 0.58 | 375. | 375. | 375. |
| 30.000 | 12.601 | 0.244 | 0.4150 | 230.29 | 2.39 | 0.02 | 19.06 | 0.25 | 0.54 | 330. | 330. | 330. |

## TABLE B-9. September Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1009.296 | 6.369 | 0.3181 | 300.39 | 11.36 | 0.46 | 1167.56 | 49.11 | -0.23 | 371. | 371. | 371. |
| 1.000 | 900.221 | 3.948 | 0.3561 | 297.73 | 7.46 | -0.03 | 1050.47 | 27.29 | 0.17 | 506. | 506. | 506. |
| 1.007 | 898.947 | 3.384 | -0.3248 | 297.63 | 7.41 | -0.03 | 1049.30 | 26.97 | 0.15 | 506. | 506. | 506. |
| 2.000 | 801.310 | 4.053 | -0.3015 | 290.90 | 4.95 | -0.80 | 957.06 | 14.80 | 0.82 | 532. | 532. | 532. |
| 3.000 | 711.827 | 4.465 | -0.6830 | 282.50 | 4.37 | -0.92 | 875.82 | 10.51 | 0.92 | 532. | 532. | 532. |
| 4.000 | 629.723 | 4.955 | -0.8566 | 275.30 | 3.74 | -1.18 | 795.63 | 7.45 | 0.99 | 532. | 532. | 532. |
| 5.000 | 555.520 | 5.119 | -0.9901 | 268.81 | 3.62 | -1.24 | 719.29 | 6.14 | 0.87 | 532. | 532. | 532. |
| 6.000 | 488.820 | 5.224 | -1.1206 | 262.27 | 3.69 | -1.12 | 648.98 | 5.12 | 0.44 | 531. | 531. | 531. |
| 7.000 | 428.220 | 5.217 | -1.1463 | 255.30 | 3.73 | -0.97 | 584.18 | 4.26 | 0.15 | 530. | 530. | 530. |
| 8.000 | 373.796 | 5.216 | -1.1274 | 247.92 | 3.72 | -0.74 | 525.17 | 4.09 | -0.33 | 529. | 529. | 529. |
| 9.000 | 324.945 | 5.017 | -1.0704 | 240.36 | 3.55 | -0.29 | 470.91 | 4.24 | -0.61 | 528. | 528. | 528. |
| 10.000 | 281.511 | 4.918 | -0.9524 | 233.14 | 3.44 | -0.02 | 420.64 | 4.98 | -1.60 | 527. | 527. | 527. |
| 11.000 | 242.663 | 4.591 | -0.7850 | 226.43 | 3.44 | -0.10 | 373.37 | 6.04 | -1.72 | 526. | 526. | 526. |
| 12.000 | 208.235 | 4.071 | -0.6554 | 220.91 | 3.30 | -0.25 | 328.44 | 6.84 | -1.33 | 526. | 526. | 526. |
| 13.000 | 178.060 | 3.533 | -0.5520 | 216.42 | 2.88 | -0.11 | 286.68 | 7.06 | -0.83 | 524. | 524. | 524. |
| 14.000 | 151.947 | 2.934 | -0.5078 | 212.79 | 2.98 | 0.48 | 248.83 | 7.17 | -0.59 | 524. | 524. | 524. |
| 15.000 | 129.195 | 2.321 | -0.4790 | 209.62 | 3.72 | 0.27 | 214.82 | 6.88 | -0.34 | 518. | 518. | 518. |
| 16.000 | 109.706 | 1.762 | -0.4801 | 207.70 | 4.07 | 0.05 | 184.11 | 5.93 | -0.24 | 518. | 518. | 518. |
| 17.000 | 93.110 | 1.322 | -0.4517 | 207.94 | 3.79 | 0.34 | 156.06 | 4.47 | -0.47 | 480. | 480. | 480. |
| 18.000 | 79.063 | 1.019 | -0.3552 | 209.73 | 3.16 | 0.72 | 131.37 | 3.09 | -0.70 | 477. | 477. | 477. |
| 19.000 | 67.241 | 0.813 | -0.2365 | 211.92 | 2.56 | 0.39 | 110.56 | 2.10 | -0.64 | 475. | 475. | 475. |
| 20.000 | 57.291 | 0.683 | -0.1543 | 214.04 | 2.10 | 0.06 | 93.25 | 1.47 | -0.49 | 472. | 472. | 472. |
| 21.000 | 48.862 | 0.580 | -0.0567 | 215.93 | 1.87 | -0.01 | 78.84 | 1.09 | -0.34 | 466. | 466. | 466. |
| 22.000 | 41.773 | 0.518 | -0.0320 | 217.60 | 1.76 | -0.13 | 66.88 | 0.83 | -0.28 | 462. | 462. | 462. |
| 23.000 | 35.723 | 0.462 | 0.0235 | 219.26 | 1.79 | -0.01 | 56.76 | 0.65 | -0.22 | 458. | 458. | 458. |
| 24.000 | 30.569 | 0.410 | 0.0664 | 220.94 | 1.89 | 0.00 | 48.20 | 0.56 | -0.33 | 452. | 452. | 452. |
| 25.000 | 26.213 | 0.368 | 0.1172 | 222.40 | 1.89 | 0.15 | 41.06 | 0.47 | -0.25 | 436. | 436. | 436. |
| 26.000 | 22.492 | 0.335 | 0.1037 | 223.82 | 1.88 | 0.27 | 35.00 | 0.39 | -0.17 | 432. | 432. | 432. |
| 27.000 | 19.308 | 0.306 | 0.1371 | 225.13 | 1.93 | 0.08 | 29.88 | 0.35 | -0.10 | 409. | 409. | 409. |
| 28.000 | 16.606 | 0.279 | 0.2054 | 226.29 | 2.09 | -0.05 | 25.56 | 0.31 | -0.08 | 385. | 385. | 385. |
| 29.000 | 14.288 | 0.258 | 0.1893 | 227.44 | 2.34 | 0.00 | 21.88 | 0.27 | -0.01 | 353. | 353. | 353. |
| 30.000 | 12.294 | 0.232 | 0.2285 | 228.45 | 2.35 | 0.07 | 18.75 | 0.24 | 0.15 | 308. | 308. | 308. |

## TABLE B-10. October Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1014.249 | 7.072 | -0.0913 | 292.71 | 11.82 | 0.55 | 1205.78 | 53.96 | -0.32 | 373. | 373. | 373. |
| 1.000 | 901.824 | 4.567 | -0.3293 | 291.18 | 7.67 | 0.20 | 1077.12 | 29.18 | 0.03 | 539. | 539. | 539. |
| 1.007 | 900.879 | 4.354 | -0.3932 | 291.11 | 7.61 | 0.19 | 1076.20 | 29.16 | 0.03 | 539. | 539. | 539. |
| 2.000 | 800.992 | 4.596 | -0.3901 | 285.18 | 5.28 | 0.03 | 976.72 | 16.09 | 0.28 | 543. | 543. | 543. |
| 3.000 | 709.844 | 5.015 | -0.2990 | 277.60 | 4.84 | -0.23 | 889.51 | 11.69 | 0.41 | 543. | 543. | 543. |
| 4.000 | 626.687 | 5.525 | -0.2844 | 271.52 | 4.50 | -0.70 | 803.39 | 8.59 | 0.61 | 543. | 543. | 543. |
| 5.000 | 551.834 | 5.856 | -0.3497 | 265.34 | 4.37 | -0.74 | 724.14 | 6.71 | 0.49 | 543. | 543. | 543. |
| 6.000 | 484.685 | 6.180 | -0.4293 | 258.55 | 4.30 | -0.75 | 652.86 | 5.61 | 0.00 | 542. | 542. | 542. |
| 7.000 | 423.792 | 6.122 | -0.5006 | 251.28 | 4.21 | -0.79 | 587.41 | 4.93 | -0.20 | 542. | 542. | 542. |
| 8.000 | 369.075 | 6.106 | -0.5341 | 243.73 | 4.08 | -0.78 | 527.46 | 4.46 | -0.40 | 541. | 541. | 541. |
| 9.000 | 320.188 | 5.841 | -0.5882 | 236.19 | 3.72 | -0.56 | 472.22 | 4.96 | -1.02 | 538. | 538. | 538. |
| 10.000 | 276.588 | 5.580 | -0.4440 | 229.29 | 3.17 | 0.32 | 420.22 | 6.55 | -1.37 | 535. | 535. | 535. |
| 11.000 | 237.880 | 5.031 | -0.3002 | 223.20 | 3.37 | 0.43 | 371.34 | 8.50 | -1.33 | 534. | 534. | 534. |
| 12.000 | 203.830 | 4.294 | -0.1500 | 218.77 | 3.78 | 0.29 | 324.69 | 9.12 | -0.88 | 533. | 533. | 533. |
| 13.000 | 174.074 | 3.586 | 0.0236 | 215.45 | 3.95 | -0.09 | 281.59 | 8.73 | -0.43 | 531. | 531. | 531. |
| 14.000 | 148.491 | 2.934 | 0.1209 | 212.83 | 3.70 | 0.04 | 243.16 | 7.61 | -0.19 | 529. | 529. | 529. |
| 15.000 | 126.257 | 2.313 | 0.2144 | 210.30 | 3.65 | 0.24 | 209.24 | 6.54 | -0.07 | 525. | 525. | 525. |
| 16.000 | 107.277 | 1.796 | 0.2708 | 208.55 | 3.73 | 0.29 | 179.28 | 5.48 | 0.01 | 525. | 525. | 525. |
| 17.000 | 91.113 | 1.402 | 0.2658 | 208.22 | 3.82 | 0.21 | 152.51 | 4.49 | 0.13 | 470. | 470. | 470. |
| 18.000 | 77.358 | 1.092 | 0.2455 | 209.23 | 3.44 | 0.17 | 128.84 | 3.27 | 0.21 | 469. | 469. | 469. |
| 19.000 | 65.769 | 0.879 | 0.2449 | 210.70 | 2.90 | 0.17 | 108.76 | 2.27 | 0.25 | 465. | 465. | 465. |
| 20.000 | 55.956 | 0.740 | 0.2177 | 212.24 | 2.50 | 0.18 | 91.86 | 1.60 | 0.33 | 463. | 463. | 463. |
| 21.000 | 47.665 | 0.633 | 0.2356 | 213.60 | 2.12 | 0.15 | 77.75 | 1.20 | 0.23 | 459. | 459. | 459. |
| 22.000 | 40.663 | 0.557 | 0.2680 | 215.09 | 1.97 | 0.21 | 65.87 | 0.94 | 0.16 | 455. | 455. | 455. |
| 23.000 | 34.706 | 0.489 | 0.2935 | 216.66 | 2.03 | 0.17 | 55.81 | 0.78 | 0.04 | 451. | 451. | 451. |
| 24.000 | 29.658 | 0.436 | 0.3045 | 218.24 | 2.10 | 0.15 | 47.35 | 0.64 | 0.06 | 438. | 438. | 438. |
| 25.000 | 25.388 | 0.391 | 0.2922 | 219.78 | 2.01 | -0.15 | 40.24 | 0.53 | -0.05 | 421. | 421. | 421. |
| 26.000 | 21.741 | 0.354 | 0.2672 | 221.30 | 2.20 | -0.29 | 34.23 | 0.47 | 0.06 | 417. | 417. | 417. |
| 27.000 | 18.654 | 0.317 | 0.2379 | 222.71 | 2.18 | -0.29 | 29.18 | 0.40 | 0.04 | 386. | 386. | 386. |
| 28.000 | 16.013 | 0.283 | 0.2042 | 223.89 | 2.33 | -0.10 | 24.91 | 0.35 | -0.02 | 367. | 367. | 367. |
| 29.000 | 13.758 | 0.264 | 0.2351 | 224.98 | 2.57 | 0.15 | 21.30 | 0.30 | 0.09 | 329. | 329. | 329. |
| 30.000 | 11.822 | 0.233 | 0.2749 | 225.96 | 2.61 | 0.05 | 18.23 | 0.26 | 0.13 | 300. | 300. | 300. |

## TABLE B-11. November Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1016.961 | 8.159 | -0.1735 | 286.73 | 10.70 | 0.34 | 1234.58 | 53.02 | -0.12 | 418. | 418. | 418. |
| 1.000 | 902.413 | 5.408 | -0.4747 | 284.18 | 6.96 | 0.25 | 1104.74 | 28.62 | -0.02 | 538. | 538. | 538. |
| 1.007 | 901.647 | 5.400 | -0.4742 | 284.15 | 6.93 | 0.25 | 1103.95 | 28.52 | -0.02 | 538. | 538. | 538. |
| 2.000 | 799.330 | 5.100 | -0.6945 | 278.84 | 5.12 | -0.11 | 997.31 | 17.07 | 0.30 | 538. | 538. | 538. |
| 3.000 | 706.659 | 5.397 | -0.6503 | 273.68 | 5.31 | -0.35 | 898.69 | 13.66 | 0.41 | 538. | 538. | 538. |
| 4.000 | 622.723 | 5.973 | -0.6136 | 267.98 | 5.44 | -0.62 | 809.11 | 11.03 | 0.69 | 538. | 538. | 538. |
| 5.000 | 547.399 | 6.505 | -0.6254 | 261.66 | 5.42 | -0.75 | 728.57 | 8.73 | 0.77 | 537. | 537. | 537. |
| 6.000 | 479.793 | 6.994 | -0.6405 | 254.79 | 5.47 | -0.80 | 655.87 | 7.07 | 0.67 | 536. | 536. | 536. |
| 7.000 | 418.760 | 7.131 | -0.6759 | 247.59 | 5.29 | -0.83 | 589.14 | 5.60 | 0.36 | 533. | 533. | 533. |
| 8.000 | 364.011 | 7.123 | -0.6777 | 240.41 | 4.59 | -0.48 | 527.42 | 5.16 | -0.56 | 531. | 531. | 531. |
| 9.000 | 315.206 | 6.825 | -0.6209 | 233.18 | 3.89 | -0.18 | 470.90 | 6.48 | -1.67 | 529. | 529. | 529. |
| 10.000 | 271.715 | 6.336 | -0.4363 | 226.51 | 3.49 | 0.33 | 417.92 | 8.76 | -1.64 | 526. | 526. | 526. |
| 11.000 | 233.255 | 5.606 | -0.2639 | 220.91 | 3.98 | 0.60 | 367.95 | 10.85 | -1.13 | 522. | 522. | 522. |
| 12.000 | 199.603 | 4.707 | -0.1122 | 216.99 | 4.95 | 0.36 | 320.65 | 11.60 | -0.66 | 522. | 522. | 522. |
| 13.000 | 170.332 | 3.825 | 0.0212 | 214.79 | 4.85 | 0.11 | 276.45 | 10.26 | -0.26 | 519. | 519. | 519. |
| 14.000 | 145.225 | 3.103 | 0.1074 | 212.86 | 4.30 | 0.29 | 237.82 | 8.50 | -0.10 | 516. | 516. | 516. |
| 15.000 | 123.520 | 2.386 | 0.1017 | 210.75 | 4.21 | 0.43 | 204.31 | 7.12 | 0.01 | 513. | 513. | 513. |
| 16.000 | 105.002 | 1.821 | 0.0835 | 209.07 | 4.36 | 0.35 | 175.08 | 6.04 | 0.10 | 513. | 513. | 513. |
| 17.000 | 89.204 | 1.376 | 0.0394 | 208.38 | 4.04 | -0.10 | 149.21 | 4.62 | 0.23 | 468. | 468. | 468. |
| 18.000 | 75.731 | 1.058 | -0.0422 | 208.91 | 3.30 | -0.04 | 126.33 | 3.17 | 0.15 | 468. | 468. | 468. |
| 19.000 | 64.357 | 0.845 | -0.1416 | 210.12 | 2.61 | 0.17 | 106.72 | 2.16 | 0.02 | 465. | 465. | 465. |
| 20.000 | 54.726 | 0.703 | -0.2194 | 211.36 | 2.26 | -0.04 | 90.21 | 1.59 | 0.05 | 465. | 465. | 465. |
| 21.000 | 46.600 | 0.594 | -0.2877 | 212.62 | 2.06 | -0.08 | 76.36 | 1.17 | -0.14 | 457. | 457. | 457. |
| 22.000 | 39.719 | 0.521 | -0.2774 | 213.94 | 2.12 | -0.14 | 64.68 | 0.95 | -0.37 | 450. | 450. | 450. |
| 23.000 | 33.875 | 0.458 | -0.2887 | 215.46 | 2.06 | -0.16 | 54.77 | 0.75 | -0.53 | 447. | 447. | 447. |
| 24.000 | 28.917 | 0.409 | -0.2765 | 216.81 | 2.22 | 0.06 | 46.46 | 0.62 | -0.75 | 432. | 432. | 432. |
| 25.000 | 24.721 | 0.368 | -0.2396 | 218.03 | 2.55 | 0.23 | 39.50 | 0.57 | -1.02 | 422. | 422. | 422. |
| 26.000 | 21.138 | 0.335 | -0.2029 | 219.17 | 2.88 | 0.56 | 33.60 | 0.51 | -1.51 | 420. | 420. | 420. |
| 27.000 | 18.113 | 0.298 | -0.0635 | 220.30 | 3.06 | 0.90 | 28.64 | 0.44 | -1.59 | 387. | 387. | 387. |
| 28.000 | 15.523 | 0.280 | -0.0465 | 221.47 | 3.27 | 1.02 | 24.42 | 0.39 | -1.42 | 353. | 353. | 353. |
| 29.000 | 13.314 | 0.263 | -0.0369 | 222.83 | 3.75 | 1.38 | 20.82 | 0.39 | -1.40 | 308. | 308. | 308. |
| 30.000 | 11.433 | 0.234 | 0.0067 | 224.11 | 3.85 | 1.36 | 17.77 | 0.34 | -1.10 | 266. | 266. | 266. |

## TABLE B-12. December Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1020.485 | 7.671 | -0.2167 | 283.43 | 10.55 | 0.11 | 1253.38 | 53.73 | 0.08 | 473. | 473. | 473. |
| 1.000 | 904.101 | 5.414 | -0.6868 | 280.67 | 6.19 | 0.25 | 1120.54 | 25.97 | 0.02 | 542. | 542. | 542. |
| 1.007 | 903.319 | 5.417 | -0.6900 | 280.66 | 6.18 | 0.25 | 1119.70 | 25.87 | 0.02 | 542. | 542. | 542. |
| 2.000 | 799.908 | 5.392 | -0.6527 | 276.85 | 4.80 | -0.45 | 1005.27 | 15.01 | 0.86 | 545. | 545. | 545. |
| 3.000 | 706.627 | 5.848 | -0.5712 | 272.48 | 5.46 | -0.80 | 902.70 | 13.37 | 1.08 | 545. | 545. | 545. |
| 4.000 | 622.221 | 6.540 | -0.6142 | 266.73 | 5.56 | -0.86 | 812.28 | 10.59 | 1.07 | 544. | 544. | 544. |
| 5.000 | 546.659 | 7.028 | -0.6900 | 260.40 | 5.38 | -0.97 | 731.10 | 8.07 | 0.81 | 543. | 543. | 543. |
| 6.000 | 478.930 | 7.441 | -0.7234 | 253.47 | 5.30 | -0.99 | 658.09 | 6.68 | 0.26 | 542. | 542. | 542. |
| 7.000 | 417.706 | 7.458 | -0.7848 | 246.20 | 5.10 | -0.82 | 590.97 | 5.65 | -0.29 | 541. | 541. | 541. |
| 8.000 | 362.778 | 7.381 | -0.7667 | 238.86 | 4.61 | -0.40 | 529.05 | 5.84 | -1.08 | 540. | 540. | 540. |
| 9.000 | 313.857 | 7.048 | -0.6688 | 231.65 | 4.05 | 0.06 | 472.00 | 7.57 | -1.97 | 538. | 538. | 538. |
| 10.000 | 270.199 | 6.465 | -0.4566 | 225.02 | 3.75 | 0.42 | 418.37 | 9.62 | -1.80 | 537. | 537. | 537. |
| 11.000 | 231.764 | 5.685 | -0.2462 | 219.58 | 4.36 | 0.70 | 367.84 | 11.55 | -1.22 | 534. | 534. | 534. |
| 12.000 | 198.193 | 4.740 | -0.0589 | 216.46 | 5.14 | 0.40 | 319.20 | 12.28 | -0.52 | 534. | 534. | 534. |
| 13.000 | 169.106 | 3.793 | 0.0819 | 214.80 | 5.26 | -0.03 | 274.49 | 10.96 | -0.07 | 530. | 530. | 530. |
| 14.000 | 144.205 | 3.027 | 0.1557 | 213.47 | 4.49 | -0.10 | 235.49 | 8.47 | 0.06 | 526. | 526. | 526. |
| 15.000 | 122.718 | 2.346 | 0.1609 | 211.54 | 4.06 | 0.09 | 202.21 | 6.80 | 0.14 | 523. | 523. | 523. |
| 16.000 | 104.386 | 1.818 | 0.1295 | 209.75 | 4.00 | 0.09 | 173.47 | 5.70 | 0.18 | 522. | 522. | 522. |
| 17.000 | 88.680 | 1.404 | 0.1055 | 208.77 | 3.89 | -0.10 | 148.06 | 4.59 | 0.28 | 482. | 482. | 482. |
| 18.000 | 75.277 | 1.065 | 0.0486 | 208.57 | 3.60 | -0.17 | 125.79 | 3.44 | 0.33 | 480. | 480. | 480. |
| 19.000 | 63.949 | 0.851 | -0.0515 | 209.59 | 3.22 | 0.11 | 106.33 | 2.37 | 0.23 | 472. | 472. | 472. |
| 20.000 | 54.350 | 0.717 | -0.0615 | 210.63 | 3.02 | 0.05 | 89.91 | 1.67 | 0.18 | 470. | 470. | 470. |
| 21.000 | 46.261 | 0.618 | 0.0707 | 211.68 | 3.03 | 0.26 | 76.15 | 1.23 | 0.10 | 452. | 452. | 452. |
| 22.000 | 39.404 | 0.560 | 0.1715 | 212.81 | 3.16 | 0.25 | 64.51 | 0.97 | -0.07 | 446. | 446. | 446. |
| 23.000 | 33.575 | 0.520 | 0.2106 | 214.01 | 3.27 | 0.25 | 54.66 | 0.75 | -0.09 | 441. | 441. | 441. |
| 24.000 | 28.638 | 0.483 | 0.2475 | 215.14 | 3.41 | 0.28 | 46.37 | 0.60 | -0.20 | 421. | 421. | 421. |
| 25.000 | 24.452 | 0.458 | 0.2527 | 216.27 | 3.39 | 0.20 | 39.39 | 0.51 | -0.16 | 412. | 412. | 412. |
| 26.000 | 20.879 | 0.430 | 0.2771 | 217.31 | 3.51 | 0.19 | 33.47 | 0.48 | -0.11 | 406. | 406. | 406. |
| 27.000 | 17.876 | 0.400 | 0.2544 | 218.40 | 3.56 | 0.28 | 28.51 | 0.45 | -0.10 | 364. | 364. | 364. |
| 28.000 | 15.305 | 0.371 | 0.2232 | 219.41 | 3.74 | 0.29 | 24.30 | 0.45 | -0.14 | 331. | 331. | 331. |
| 29.000 | 13.109 | 0.350 | 0.2641 | 220.21 | 3.83 | 0.33 | 20.73 | 0.45 | -0.02 | 285. | 285. | 285. |
| 30.000 | 11.217 | 0.318 | 0.3310 | 221.30 | 4.09 | 0.48 | 17.66 | 0.43 | 0.04 | 236. | 236. | 236. |

## TABLE B-13. Annual Thermodynamic Data, Nellis.

| Z KM | MEAN P MB | S.D. P MB | SKEW P | MEAN T DEG K | S.D. T DEG K | SKEW T | MEAN D G/M3 | S.D. D G/M3 | SKEW D | NOBS P | NOBS T | NOBS D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 1013.131 | 8.501 | 0.3146 | 292.80 | 13.18 | 0.38 | 1204.36 | 62.41 | -0.04 | 4409. | 4409. | 4409. |
| 1.000 | 900.841 | 4.933 | 0.0960 | 290.91 | 10.65 | 0.19 | 1077.48 | 41.71 | 0.01 | 6103. | 6103. | 6103. |
| 1.097 | 899.965 | 4.851 | 0.1063 | 290.86 | 10.61 | 0.19 | 1076.63 | 41.65 | 0.01 | 6103. | 6103. | 6103. |
| 2.000 | 799.886 | 4.839 | -0.6421 | 284.82 | 8.70 | -0.02 | 977.08 | 28.12 | 0.10 | 6165. | 6165. | 6165. |
| 3.000 | 708.784 | 5.962 | -0.6132 | 277.69 | 7.60 | -0.18 | 888.17 | 19.28 | 0.20 | 6164. | 6164. | 6164. |
| 4.000 | 625.605 | 7.141 | -0.5365 | 270.98 | 6.90 | -0.42 | 803.64 | 13.27 | 0.44 | 6161. | 6161. | 6161. |
| 5.000 | 550.727 | 7.951 | -0.5210 | 264.35 | 6.67 | -0.55 | 725.43 | 9.69 | 0.57 | 6156. | 6156. | 6156. |
| 6.000 | 483.459 | 8.641 | -0.5279 | 257.47 | 6.77 | -0.57 | 654.01 | 7.51 | 0.48 | 6141. | 6140. | 6141. |
| 7.000 | 422.513 | 8.886 | -0.5336 | 250.30 | 6.86 | -0.46 | 588.01 | 5.99 | 0.26 | 6120. | 6119. | 6120. |
| 8.000 | 367.805 | 9.085 | -0.4974 | 242.90 | 6.73 | -0.26 | 527.49 | 5.05 | -0.26 | 6100. | 6100. | 6100. |
| 9.000 | 318.893 | 8.950 | -0.4472 | 235.47 | 6.42 | -0.05 | 471.77 | 5.57 | -1.56 | 6079. | 6079. | 6079. |
| 10.000 | 275.324 | 8.793 | -0.3036 | 228.48 | 5.95 | 0.10 | 419.77 | 7.41 | -2.10 | 6060. | 6060. | 6060. |
| 11.000 | 236.669 | 8.246 | -0.1660 | 222.43 | 5.52 | 0.05 | 370.68 | 9.84 | -1.68 | 6032. | 6032. | 6032. |
| 12.000 | 202.683 | 7.363 | -0.0435 | 218.26 | 5.08 | -0.21 | 323.60 | 11.78 | -1.02 | 6019. | 6019. | 6019. |
| 13.000 | 173.128 | 6.366 | 0.0797 | 215.78 | 4.45 | -0.31 | 279.65 | 12.27 | -0.44 | 5993. | 5993. | 5993. |
| 14.000 | 147.718 | 5.331 | 0.1347 | 213.73 | 4.09 | 0.11 | 240.93 | 11.60 | -0.05 | 5972. | 5972. | 5972. |
| 15.000 | 125.730 | 4.326 | 0.1684 | 211.49 | 4.30 | 0.14 | 207.28 | 10.30 | 0.13 | 5941. | 5941. | 5941. |
| 16.000 | 106.932 | 3.447 | 0.1726 | 209.84 | 4.39 | 0.10 | 177.67 | 8.50 | 0.14 | 5936. | 5936. | 5936. |
| 17.000 | 90.865 | 2.789 | 0.1753 | 209.47 | 4.03 | 0.16 | 151.21 | 6.50 | 0.05 | 5510. | 5510. | 5510. |
| 18.000 | 77.211 | 2.297 | 0.2032 | 210.16 | 3.50 | 0.07 | 128.04 | 4.71 | -0.03 | 5487. | 5487. | 5487. |
| 19.000 | 65.692 | 1.937 | 0.2092 | 211.63 | 3.08 | -0.17 | 108.15 | 3.38 | -0.07 | 5425. | 5425. | 5425. |
| 20.000 | 55.940 | 1.691 | 0.2223 | 213.11 | 2.96 | -0.44 | 91.45 | 2.53 | -0.03 | 5404. | 5404. | 5404. |
| 21.000 | 47.696 | 1.479 | 0.2076 | 214.55 | 3.02 | -0.56 | 77.44 | 1.95 | 0.03 | 5314. | 5314. | 5314. |
| 22.000 | 40.734 | 1.331 | 0.1909 | 215.99 | 3.19 | -0.60 | 65.69 | 1.62 | 0.09 | 5247. | 5247. | 5247. |
| 23.000 | 34.793 | 1.199 | 0.1702 | 217.45 | 3.32 | -0.64 | 55.73 | 1.38 | 0.16 | 5192. | 5192. | 5192. |
| 24.000 | 29.757 | 1.072 | 0.1357 | 218.93 | 3.53 | -0.63 | 47.34 | 1.18 | 0.18 | 5067. | 5067. | 5067. |
| 25.000 | 25.475 | 0.973 | 0.1113 | 220.34 | 3.77 | -0.64 | 40.27 | 1.04 | 0.14 | 4913. | 4913. | 4913. |
| 26.000 | 21.830 | 0.882 | 0.1001 | 221.83 | 3.99 | -0.55 | 34.27 | 0.94 | 0.09 | 4836. | 4835. | 4836. |
| 27.000 | 18.750 | 0.789 | 0.0597 | 223.33 | 4.19 | -0.54 | 29.24 | 0.83 | 0.04 | 4450. | 4450. | 4450. |
| 28.000 | 16.116 | 0.713 | 0.0345 | 224.75 | 4.41 | -0.50 | 24.97 | 0.76 | -0.02 | 4097. | 4097. | 4097. |
| 29.000 | 13.879 | 0.642 | -0.0051 | 226.29 | 4.64 | -0.48 | 21.36 | 0.69 | -0.08 | 3635. | 3635. | 3635. |
| 30.000 | 11.944 | 0.575 | -0.0289 | 227.77 | 4.76 | -0.50 | 18.26 | 0.63 | -0.12 | 3135. | 3135. | 3135. |

# APPENDIX C

## Nellis Moisture-Related Statistics Tables

Tables C-1 through C-13 provide moisture related statistics (monthly and annual) for Nellis. They were prepared as described in Chapter 3.

## TABLE C-1. January Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 6.728 | 3.138 | 1.0780 | 284.87 | 9.90 | 0.13 | 273.19 | 6.50 | -0.17 | 392. | 392. | 392. |
| 1.000 | 4.702 | 1.953 | 0.9046 | 281.40 | 6.33 | -0.19 | 268.66 | 5.43 | 0.02 | 482. | 482. | 481. |
| 1.007 | 4.691 | 1.938 | 0.9363 | 281.44 | 6.13 | 0.12 | 268.60 | 5.44 | 0.02 | 482. | 482. | 482. |
| 2.000 | 3.302 | 1.722 | 0.7689 | 276.54 | 4.95 | -0.34 | 263.33 | 7.09 | -0.31 | 483. | 483. | 483. |
| 3.000 | 2.007 | 1.291 | 0.7958 | 271.54 | 5.38 | -0.56 | 256.24 | 8.60 | -0.27 | 482. | 482. | 482. |
| 4.000 | 1.171 | 0.902 | 1.0658 | 265.85 | 5.50 | -0.78 | 249.17 | 9.28 | -0.04 | 483. | 483. | 483. |
| 5.000 | 0.696 | 0.581 | 1.2823 | 259.35 | 5.54 | -0.88 | 242.91 | 9.74 | -0.14 | 482. | 482. | 482. |
| 6.000 | 0.407 | 0.347 | 1.2371 | 252.43 | 5.53 | -0.90 | 237.03 | 9.80 | -0.20 | 479. | 479. | 479. |
| 7.000 | 0.225 | 0.196 | 1.2882 | 245.77 | 4.54 | -0.48 | 230.88 | 10.03 | -0.41 | 455. | 455. | 455. |
| 8.000 | 0.125 | 0.100 | 1.1958 | 239.47 | 3.19 | 0.16 | 225.74 | 9.38 | -0.62 | 365. | 365. | 365. |
| 9.000 | 0.079 | 0.055 | 0.7008 | 235.56 | 1.64 | 0.96 | 222.15 | 8.52 | -0.86 | 99. | 99. | 99. |
| 10.000 | 0.000 | 0.000 | 0.0000 | 223.56 | 3.60 | 0.03 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 218.60 | 4.36 | 0.90 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 216.65 | 5.62 | 0.45 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 216.54 | 5.24 | -0.41 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 215.75 | 3.97 | -0.16 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 213.53 | 3.64 | 0.25 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 211.25 | 3.88 | 0.24 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 210.08 | 3.82 | 0.09 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 209.90 | 3.85 | -0.15 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 210.63 | 3.81 | -0.36 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 211.53 | 3.82 | -0.41 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 212.45 | 3.89 | -0.48 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 213.51 | 4.11 | -0.37 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 214.51 | 4.18 | -0.42 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 215.55 | 4.22 | -0.45 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 216.50 | 4.32 | -0.58 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 217.74 | 4.28 | -0.47 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 218.91 | 4.26 | -0.57 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 220.15 | 4.47 | -0.36 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 221.49 | 4.69 | -0.45 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 223.31 | 5.07 | -0.53 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-2. February Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 7.183 | 3.296 | 0.9112 | 285.20 | 10.30 | 0.27 | 274.15 | 6.56 | -0.31 | 325. | 325. | 324. |
| 1.000 | 4.762 | 2.034 | 0.5964 | 282.69 | 7.62 | -0.88 | 268.64 | 6.14 | -0.77 | 446. | 446. | 445. |
| 1.007 | 4.776 | 2.002 | 0.6552 | 282.88 | 6.88 | 0.08 | 268.74 | 5.80 | -0.26 | 446. | 446 | 446. |
| 2.000 | 3.153 | 1.645 | 0.7845 | 277.17 | 5.06 | -0.26 | 262.67 | 7.34 | -0.57 | 446. | 446. | 446. |
| 3.000 | 1.960 | 1.272 | 0.7517 | 271.41 | 5.16 | -0.48 | 255.77 | 9.05 | -0.44 | 443. | 443. | 443. |
| 4.000 | 1.100 | 0.850 | 1.0959 | 265.48 | 5.05 | -0.65 | 248.45 | 9.27 | -0.04 | 444. | 444. | 444. |
| 5.000 | 0.676 | 0.594 | 1.5093 | 258.84 | 5.07 | -0.53 | 242.39 | 9.90 | -0.05 | 444. | 444. | 444. |
| 6.000 | 0.417 | 0.375 | 1.6186 | 251.67 | 5.15 | -0.51 | 237.07 | 10.14 | -0.24 | 441. | 441. | 441. |
| 7.000 | 0.234 | 0.198 | 1.4836 | 244.65 | 4.48 | -0.01 | 231.53 | 9.75 | -0.56 | 423. | 423. | 423. |
| 8.000 | 0.138 | 0.100 | 1.2423 | 238.77 | 3.26 | 0.58 | 227.47 | 8.21 | -0.83 | 311. | 311. | 311. |
| 9.000 | 0.098 | 0.052 | 1.1235 | 235.76 | 1.89 | 1.18 | 225.47 | 6.50 | -1.71 | 59. | 59. | 59. |
| 10.000 | 0.000 | 0.000 | 0.0000 | 222.27 | 3.77 | 0.38 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 217.01 | 4.41 | 0.99 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 215.45 | 5.82 | 0.27 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 216.27 | 5.20 | -0.69 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 215.85 | 3.96 | -0.50 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 214.03 | 3.53 | -0.26 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 212.21 | 3.77 | -0.24 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 210.96 | 4.10 | -0.34 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 210.67 | 4.05 | -0.32 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 211.49 | 3.76 | -0.33 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 212.41 | 3.46 | -0.30 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 213.40 | 3.29 | -0.18 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 214.57 | 3.24 | -0.20 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 215.68 | 3.03 | -0.28 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 216.84 | 2.99 | -0.25 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 217.94 | 2.95 | -0.43 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 219.26 | 2.87 | -0.47 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 220.45 | 2.96 | -0.84 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 221.61 | 3.20 | -0.68 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 222.91 | 3.22 | -0.23 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 224.26 | 3.31 | 0.18 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-3. March Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 8.220 | 2.914 | 0.2917 | 286.18 | 7.64 | 0.79 | 276.43 | 5.51 | -0.65 | 297. | 297. | 297. |
| 1.000 | 5.267 | 1.931 | 0.2505 | 285.10 | 6.74 | -0.33 | 270.29 | 5.24 | -0.38 | 491. | 491. | 490. |
| 1.007 | 5.264 | 1.916 | 0.2751 | 285.14 | 6.39 | 0.31 | 270.27 | 5.25 | -0.38 | 491. | 491. | 491. |
| 2.000 | 3.538 | 1.487 | 0.2550 | 278.10 | 4.42 | 0.29 | 264.68 | 6.15 | -0.68 | 490. | 490. | 490. |
| 3.000 | 2.338 | 1.147 | 0.2286 | 270.66 | 4.27 | 0.09 | 258.85 | 7.63 | -1.02 | 490. | 490. | 490. |
| 4.000 | 1.181 | 0.835 | 0.8554 | 264.28 | 4.46 | -0.22 | 249.48 | 9.23 | -0.33 | 488. | 488. | 488. |
| 5.000 | 0.629 | 0.521 | 1.3590 | 257.68 | 4.67 | -0.36 | 241.96 | 9.47 | -0.15 | 488. | 488. | 488. |
| 6.000 | 0.346 | 0.299 | 1.6453 | 250.56 | 4.69 | -0.44 | 235.60 | 9.37 | -0.23 | 488. | 488. | 488. |
| 7.000 | 0.190 | 0.160 | 1.4747 | 243.37 | 4.30 | -0.21 | 229.76 | 9.29 | -0.53 | 472. | 472. | 472. |
| 8.000 | 0.111 | 0.085 | 1.1398 | 237.88 | 2.73 | 0.47 | 225.00 | 8.82 | -0.74 | 320. | 320. | 320. |
| 9.000 | 0.082 | 0.048 | 0.2783 | 234.47 | 1.26 | 2.25 | 223.04 | 8.14 | -1.46 | 41. | 41. | 41. |
| 10.000 | 0.000 | 0.000 | 0.0000 | 222.14 | 3.26 | 0.22 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 217.90 | 4.26 | 0.68 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 216.77 | 5.76 | -0.02 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 217.08 | 5.33 | -0.60 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 216.69 | 3.92 | -0.54 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 215.03 | 3.46 | -0.16 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 213.24 | 3.58 | -0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 212.36 | 3.77 | 0.00 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 211.99 | 3.54 | -0.19 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 212.48 | 3.00 | 0.08 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 213.13 | 2.76 | 0.08 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 213.89 | 2.57 | -0.06 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 214.60 | 2.49 | -0.02 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 215.61 | 2.43 | 0.01 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 216.63 | 2.48 | -0.19 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 217.73 | 2.69 | -0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 219.15 | 2.64 | 0.13 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 220.67 | 2.85 | 0.09 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 222.23 | 3.19 | 0.59 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 223.96 | 3.54 | 0.63 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 225.76 | 3.74 | 0.35 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-4. April Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 7.323 | 3.089 | 0.8483 | 289.89 | 8.53 | 0.83 | 274.53 | 6.24 | -0.65 | 288. | 288. | 288. |
| 1.000 | 4.645 | 1.817 | 0.7602 | 289.32 | 7.27 | 0.21 | 268.53 | 5.56 | -0.34 | 476. | 477. | 477. |
| 1.007 | 4.629 | 1.805 | 0.7591 | 289.28 | 7.26 | 0.21 | 268.51 | 5.55 | -0.34 | 476. | 477. | 477. |
| 2.000 | 3.248 | 1.366 | 0.8526 | 282.14 | 5.41 | -0.19 | 263.72 | 5.63 | -0.38 | 477. | 477. | 477. |
| 3.000 | 2.322 | 1.124 | 0.7489 | 274.02 | 5.09 | -0.42 | 259.09 | 6.63 | -0.61 | 476. | 476. | 476. |
| 4.000 | 1.270 | 0.825 | 1.0801 | 267.07 | 5.05 | -0.86 | 251.03 | 7.90 | -0.18 | 476. | 476. | 476. |
| 5.000 | 0.642 | 0.517 | 1.6564 | 260.52 | 5.09 | -1.12 | 242.75 | 8.43 | 0.09 | 476. | 476. | 476. |
| 6.000 | 0.365 | 0.304 | 1.6279 | 253.43 | 5.14 | -1.21 | 236.55 | 8.74 | -0.13 | 474. | 474. | 474. |
| 7.000 | 0.217 | 0.174 | 1.2541 | 246.62 | 4.12 | -0.83 | 231.10 | 9.28 | -0.50 | 459. | 459. | 459. |
| 8.000 | 0.120 | 0.086 | 1.0113 | 239.88 | 2.90 | 0.02 | 225.92 | 8.56 | -0.77 | 395. | 395. | 395. |
| 9.000 | 0.074 | 0.044 | 0.5413 | 235.26 | 1.41 | 0.84 | 222.33 | 7.37 | -1.23 | 121. | 121. | 121. |
| 10.000 | 0.000 | 0.000 | 0.0000 | 224.41 | 2.97 | 0.05 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 218.41 | 3.53 | 1.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 214.75 | 4.88 | 0.75 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 214.52 | 5.32 | -0.05 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 214.71 | 4.03 | -0.26 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 213.69 | 3.41 | 0.30 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 212.71 | 3.34 | 0.43 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 212.26 | 3.37 | 0.23 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 212.41 | 3.27 | -0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 213.16 | 3.20 | 0.08 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 213.89 | 2.82 | 0.15 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 214.79 | 2.55 | 0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 215.97 | 2.40 | -0.02 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 217.31 | 2.33 | -0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 218.51 | 2.27 | -0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 220.11 | 2.40 | -0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 221.77 | 2.73 | 0.25 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 223.42 | 2.85 | 0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 225.13 | 3.02 | 0.32 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 227.02 | 3.19 | 0.20 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 228.83 | 3.07 | 0.03 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-5. May Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 8.213 | 4.241 | 0.9431 | 296.53 | 9.96 | 0.84 | 275.52 | 7.87 | -0.52 | 306. | 306. | 306. |
| 1.000 | 5.639 | 2.313 | 1.2035 | 295.05 | 7.70 | 0.14 | 271.09 | 5.41 | 0.01 | 473. | 473. | 473. |
| 1.007 | 5.627 | 2.306 | 1.2021 | 295.00 | 7.68 | 0.14 | 271.09 | 5.40 | 0.01 | 473. | 473. | 473. |
| 2.000 | 4.153 | 1.781 | 1.0991 | 287.79 | 5.51 | -0.29 | 266.91 | 5.67 | -0.18 | 473. | 473. | 473. |
| 3.000 | 3.119 | 1.294 | 0.5421 | 279.19 | 5.10 | -0.35 | 263.13 | 5.92 | -0.77 | 473. | 473. | 473. |
| 4.000 | 1.954 | 1.096 | 0.4664 | 271.43 | 4.75 | -0.56 | 256.36 | 7.89 | -0.50 | 473. | 473. | 473. |
| 5.000 | 0.975 | 0.781 | 1.0960 | 264.52 | 4.48 | -0.85 | 246.93 | 9.37 | 0.04 | 473. | 473. | 473. |
| 6.000 | 0.497 | 0.421 | 1.5752 | 257.49 | 4.55 | -1.03 | 239.55 | 9.11 | -0.05 | 472. | 472. | 472. |
| 7.000 | 0.255 | 0.218 | 1.4655 | 250.29 | 4.45 | -0.88 | 232.66 | 8.98 | -0.15 | 467. | 467. | 467. |
| 8.000 | 0.138 | 0.111 | 1.1331 | 243.20 | 3.61 | -0.27 | 226.88 | 8.75 | -0.35 | 434. | 434. | 434. |
| 9.000 | 0.077 | 0.052 | 0.7277 | 237.16 | 2.24 | 0.42 | 222.07 | 8.24 | -0.87 | 292. | 292. | 292. |
| 10.000 | 0.037 | 0.031 | 0.1396 | 234.54 | 0.66 | -0.03 | 214.57 | 9.62 | -0.16 | 11. | 11. | 11. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 221.04 | 3.14 | 0.46 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 216.31 | 4.07 | 0.80 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 214.39 | 4.96 | 0.25 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 214.21 | 4.72 | -0.42 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 213.61 | 3.79 | -0.37 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 212.48 | 3.49 | -0.25 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 211.92 | 3.42 | -0.03 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 211.97 | 3.27 | 0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 212.78 | 2.84 | -0.05 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 214.07 | 2.59 | 0.01 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 215.75 | 2.36 | -0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 217.39 | 2.25 | -0.19 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 219.11 | 2.17 | -0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 220.86 | 2.24 | -0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 222.55 | 2.25 | -0.27 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 224.37 | 2.32 | -0.10 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 226.17 | 2.38 | -0.24 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 227.97 | 2.50 | -0.09 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 229.78 | 2.56 | 0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 231.59 | 2.50 | 0.26 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-6. June Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 7.158 | 4.079 | 0.6811 | 302.04 | 10.92 | 0.60 | 273.01 | 9.10 | -0.56 | 356. | 356. | 356. |
| 1.000 | 5.843 | 2.312 | 0.5737 | 300.43 | 7.64 | 0.10 | 271.56 | 5.56 | -0.15 | 514. | 516. | 514. |
| 1.007 | 5.830 | 2.304 | 0.5741 | 300.36 | 7.62 | 0.10 | 271.55 | 5.55 | -0.15 | 514. | 516. | 514. |
| 2.000 | 4.897 | 1.846 | 0.5379 | 293.43 | 4.54 | -0.44 | 269.29 | 5.20 | -0.19 | 528. | 528. | 528. |
| 3.000 | 3.437 | 1.469 | 0.2934 | 284.74 | 4.08 | -0.41 | 264.29 | 6.12 | -0.51 | 528. | 528. | 528. |
| 4.000 | 2.246 | 1.216 | 0.4780 | 276.78 | 3.74 | -0.56 | 258.26 | 7.49 | -0.38 | 527. | 527. | 527. |
| 5.000 | 1.278 | 0.963 | 1.1371 | 269.47 | 3.50 | -0.84 | 242 | 8.89 | 0.06 | 527. | 527. | 527. |
| 6.000 | 0.669 | 0.594 | 1.5738 | 262.39 | 3.32 | -0.90 | 242.55 | 9.26 | 0.21 | 526. | 526. | 526. |
| 7.000 | 0.359 | 0.320 | 1.8117 | 255.10 | 3.27 | -0.81 | 236.19 | 8.80 | 0.08 | 525. | 525. | 525. |
| 8.000 | 0.200 | 0.171 | 1.6556 | 247.58 | 3.19 | -0.64 | 230.45 | 8.67 | -0.15 | 515. | 515. | 515. |
| 9.000 | 0.102 | 0.081 | 1.3738 | 240.14 | 2.77 | -0.08 | 224.29 | 8.42 | -0.48 | 498. | 498. | 498. |
| 10.000 | 0.057 | 0.040 | 0.7536 | 235.20 | 1.44 | 0.67 | 219.42 | 8.33 | -0.76 | 175. | 175. | 175. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 225.14 | 2.85 | -0.31 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 219.24 | 3.10 | 0.26 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 215.51 | 3.62 | 0.20 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 213.44 | 3.71 | -0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 211.45 | 3.72 | -0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 209.90 | 3.75 | 0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 209.14 | 3.48 | 0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 210.13 | 3.01 | 0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 212.27 | 2.48 | 0.06 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 214.38 | 2.19 | -0.01 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 216.31 | 1.96 | 0.06 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 218.17 | 1.84 | -0.01 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 219.99 | 1.82 | 0.03 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 221.83 | 1.81 | -0.19 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 223.77 | 1.84 | -0.18 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 225.56 | 1.94 | -0.03 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 227.35 | 1.91 | -0.02 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 229.06 | 1.93 | -0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 230.78 | 2.04 | -0.20 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 232.51 | 2.16 | -0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-7. July Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 11.924 | 8.402 | 0.8708 | 305.96 | 10.61 | 0.52 | 279.29 | 11.00 | -0.05 | 396. | 396. | 396. |
| 1.000 | 8.819 | 4.606 | 0.9339 | 303.59 | 7.03 | 0.04 | 276.72 | 7.43 | 0.32 | 549. | 550. | 550. |
| 1.007 | 8.802 | 4.594 | 0.9330 | 303.53 | 7.02 | 0.04 | 276.71 | 7.43 | 0.32 | 549. | 550. | 550. |
| 2.000 | 6.816 | 2.846 | 0.7819 | 296.56 | 3.46 | -0.39 | 273.64 | 5.70 | 0.14 | 558. | 558. | 558. |
| 3.000 | 5.129 | 2.333 | 0.4910 | 287.92 | 2.91 | -0.46 | 269.42 | 6.62 | -0.38 | 558. | 558. | 558. |
| 4.000 | 3.453 | 1.958 | 0.3376 | 279.85 | 2.40 | -0.75 | 263.33 | 8.40 | -0.36 | 557. | 557. | 557. |
| 5.000 | 2.033 | 1.484 | 0.6487 | 272.46 | 2.12 | -0.83 | 255.62 | 9.75 | -0.02 | 556. | 556. | 556. |
| 6.000 | 1.047 | 0.918 | 0.9871 | 265.52 | 2.12 | -1.03 | 246.99 | 10.26 | 0.23 | 555. | 555. | 555. |
| 7.000 | 0.516 | 0.472 | 1.2863 | 258.64 | 2.32 | -1.09 | 239.44 | 9.56 | 0.27 | 553. | 553. | 553. |
| 8.000 | 0.262 | 0.245 | 1.4224 | 251.50 | 2.44 | -1.08 | 232.46 | 9.38 | 0.17 | 546. | 546. | 546. |
| 9.000 | 0.133 | 0.120 | 1.3645 | 244.08 | 2.48 | -0.62 | 226.12 | 9.07 | -0.06 | 543. | 543. | 543. |
| 10.000 | 0.065 | 0.054 | 0.9519 | 237.18 | 1.91 | 0.13 | 219.76 | 9.04 | -0.32 | 467. | 467. | 467. |
| 11.000 | 0.036 | 0.035 | 0.6416 | 234.90 | 2.27 | 0.72 | 214.45 | 9.66 | -0.03 | 11. | 11. | 11. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 222.66 | 2.32 | -0.03 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 216.72 | 2.27 | 0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 211.52 | 2.73 | 0.86 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 207.78 | 3.14 | 1.11 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 206.37 | 3.22 | 0.94 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 207.22 | 2.73 | 0.63 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 209.27 | 2.40 | 0.28 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 212.08 | 1.93 | 0.27 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 214.61 | 1.72 | 0.16 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 216.76 | 1.69 | 0.16 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 218.75 | 1.80 | 0.35 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 220.50 | 1.70 | 0.28 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 222.17 | 1.72 | 0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 223.91 | 1.75 | 0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 225.65 | 1.84 | 0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 227.35 | 1.99 | 0.03 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 228.95 | 2.05 | 0.02 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 230.59 | 2.27 | -0.26 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 232.09 | 2.26 | -0.14 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-8. August Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 14.001 | 8.120 | 0.5022 | 306.21 | 10.55 | 0.39 | 282.48 | 10.05 | -0.45 | 414. | 414. | 414. |
| 1.000 | 10.011 | 4.768 | 0.5795 | 303.05 | 6.95 | 0.06 | 278.60 | 7.27 | -0.20 | 543. | 543. | 543. |
| 1.007 | 9.982 | 4.756 | 0.5800 | 302.95 | 6.92 | 0.06 | 278.57 | 7.28 | -0.20 | 543. | 543. | 543. |
| 2.000 | 7.416 | 3.050 | 0.6627 | 296.06 | 3.54 | -0.17 | 274.80 | 5.83 | -0.04 | 551. | 551. | 551. |
| 3.000 | 5.574 | 2.437 | 0.2874 | 287.36 | 3.04 | -0.11 | 270.57 | 6.68 | -0.57 | 551. | 551. | 551. |
| 4.000 | 3.652 | 1.974 | 0.2826 | 279.29 | 2.50 | -0.31 | 264.20 | 8.21 | -0.50 | 551. | 551. | 551. |
| 5.000 | 2.005 | 1.442 | 0.7403 | 272.00 | 2.16 | -0.51 | 255.63 | 9.44 | -0.04 | 551. | 551. | 551. |
| 6.000 | 1.012 | 0.884 | 1.2267 | 265.17 | 2.11 | -0.48 | 246.90 | 9.84 | 0.21 | 549. | 549. | 549. |
| 7.000 | 0.483 | 0.450 | 1.7804 | 258.27 | 2.26 | -0.62 | 239.04 | 9.06 | 0.29 | 546. | 546. | 546. |
| 8.000 | 0.260 | 0.238 | 1.6378 | 251.03 | 2.43 | -0.53 | 232.66 | 9.03 | 0.11 | 544. | 544. | 544. |
| 9.000 | 0.139 | 0.119 | 1.4967 | 243.52 | 2.76 | -0.36 | 226.97 | 8.58 | -0.19 | 541. | 541. | 541. |
| 10.000 | 0.076 | 0.061 | 1.0993 | 237.24 | 1.98 | 0.34 | 221.48 | 8.79 | -0.50 | 400. | 400. | 400. |
| 11.000 | 0.038 | 0.041 | 1.1523 | 234.04 | 0.69 | 1.14 | 213.43 | 10.31 | 0.32 | 19. | 19. | 19. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 222.45 | 2.42 | -0.34 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 216.78 | 2.05 | 0.37 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 211.89 | 2.56 | 0.71 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 208.28 | 3.36 | 0.85 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 206.64 | 3.58 | 0.56 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 207.57 | 3.00 | 0.44 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 209.79 | 2.38 | 0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 212.52 | 1.98 | 0.00 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 214.78 | 1.74 | 0.11 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 216.79 | 1.63 | 0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 218.46 | 1.56 | 0.01 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 220.07 | 1.54 | -0.02 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 221.71 | 1.63 | 0.05 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 223.28 | 1.70 | 0.10 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 224.89 | 1.86 | 0.19 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 226.37 | 2.01 | 0.34 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 227.70 | 2.07 | 0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 229.01 | 2.24 | 0.13 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 230.29 | 2.39 | 0.02 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-9. September Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 10.863 | 6.018 | 0.6131 | 301.56 | 11.39 | 0.40 | 278.96 | 9.48 | -0.66 | 371. | 371. | 371. |
| 1.000 | 8.042 | 3.409 | 0.7087 | 298.73 | 7.46 | -0.06 | 275.81 | 6.28 | -0.30 | 506. | 506. | 506. |
| 1.007 | 8.016 | 3.391 | 0.6932 | 298.64 | 7.44 | -0.06 | 275.78 | 6.28 | -0.31 | 506. | 506. | 506. |
| 2.000 | 6.195 | 2.378 | 0.6182 | 291.75 | 5.03 | -0.81 | 272.40 | 5.60 | -0.47 | 532. | 532. | 532. |
| 3.000 | 4.595 | 1.960 | 0.3957 | 283.19 | 4.45 | -0.91 | 268.02 | 6.56 | -0.89 | 532. | 532. | 532. |
| 4.000 | 2.741 | 1.579 | 0.5906 | 275.76 | 3.79 | -1.18 | 260.41 | 8.30 | -0.51 | 532. | 532. | 532. |
| 5.000 | 1.141 | 1.090 | 1.1638 | 269.07 | 3.63 | -1.27 | 251.77 | 9.04 | 0.00 | 532. | 532. | 532. |
| 6.000 | 0.702 | 0.565 | 1.6136 | 262.42 | 3.70 | -1.13 | 243.71 | 8.49 | 0.09 | 530. | 530. | 530. |
| 7.000 | 0.362 | 0.278 | 1.7424 | 255.38 | 3.75 | -0.97 | 237.11 | 7.95 | -0.06 | 526. | 528. | 528. |
| 8.000 | 0.207 | 0.158 | 1.8264 | 248.03 | 3.67 | -0.68 | 231.45 | 7.79 | -0.33 | 523. | 523. | 523. |
| 9.000 | 0.108 | 0.079 | 1.8933 | 240.75 | 3.25 | -0.11 | 225.67 | 7.37 | -0.63 | 501. | 502. | 502. |
| 10.000 | 0.063 | 0.044 | 1.0230 | 236.37 | 1.88 | 0.43 | 220.53 | 7.84 | -0.73 | 223. | 223. | 223. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 226.43 | 3.44 | -0.10 | 0.00 | 0.00 | 0.00 | 2. | 0. | 2. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 220.91 | 3.30 | -0.25 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 216.42 | 2.88 | -0.11 | 0.00 | 0.00 | .00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 212.79 | 2.98 | 0.48 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 209.62 | 3.72 | 0.27 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 207.70 | 4.07 | 0.05 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 207.94 | 3.79 | 0.34 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 209.73 | 3.16 | 0.72 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 211.92 | 2.56 | 0.39 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 214.04 | 2.10 | 0.06 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 215.93 | 1.87 | -0.01 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 217.60 | 1.76 | -0.13 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 219.26 | 1.79 | -0.01 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 220.94 | 1.89 | 0.00 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 222.40 | 1.89 | 0.15 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 223.82 | 1.88 | 0.27 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 225.13 | 1.93 | 0.08 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 226.29 | 2.09 | -0.05 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 227.44 | 2.34 | 0.00 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 228.45 | 2.35 | 0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-10. October Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 7.673 | 3.914 | 0.7947 | 293.52 | 11.83 | 0.52 | 274.61 | 7.64 | -0.33 | 373. | 373. | 373. |
| 1.000 | 5.768 | 2.386 | 0.7061 | 291.82 | 7.91 | -0.17 | 271.29 | 5.87 | -0.43 | 539. | 539. | 539. |
| 1.007 | 5.766 | 2.368 | 0.7246 | 291.82 | 7.64 | 0.17 | 271.34 | 5.70 | -0.13 | 539. | 539. | 539. |
| 2.000 | 4.433 | 1.785 | 0.5556 | 285.78 | 5.35 | 0.03 | 267.79 | 5.75 | -0.51 | 543. | 543. | 543. |
| 3.000 | 3.107 | 1.423 | 0.1602 | 278.08 | 4.86 | -0.24 | 262.64 | 7.22 | -1.01 | 542. | 542. | 542. |
| 4.000 | 1.652 | 1.008 | 0.6738 | 271.79 | 4.51 | -0.70 | 254.14 | 8.09 | -0.30 | 542. | 542. | 542. |
| 5.000 | 0.911 | 0.660 | 1.2684 | 265.51 | 4.38 | -0.76 | 246.96 | 8.06 | 0.05 | 543. | 543. | 543. |
| 6.000 | 0.545 | 0.423 | 1.3[illegible] | 258.65 | 4.31 | -0.76 | 240.96 | 8.58 | -0.09 | 542. | 542. | 542. |
| 7.000 | 0.307 | 0.250 | 1.5959 | 251.38 | 4.16 | -0.72 | 234.87 | 8.58 | -0.21 | 541. | 541. | 541. |
| 8.000 | 0.171 | 0.135 | 1.4386 | 244.09 | 3.60 | -0.20 | 229.22 | 8.50 | -0.45 | 523. | 523. | 523. |
| 9.000 | 0.094 | 0.066 | 1.3348 | 237.58 | 2.65 | 0.55 | 224.13 | 7.78 | -0.86 | 418. | 418. | 418. |
| 10.000 | 0.064 | 0.047 | 0.8032 | 235.27 | 1.50 | 0.68 | 220.30 | 8.42 | -0.71 | 48. | 48. | 48. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 223.20 | 3.37 | 0.43 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 218.77 | 3.78 | 0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 215.45 | 3.95 | -0.09 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 212.83 | 3.70 | 0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 210.30 | 3.65 | 0.24 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 208.55 | 3.73 | 0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 208.22 | 3.82 | 0.21 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 209.23 | 3.44 | 0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 210.70 | 2.90 | 0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 212.24 | 2.50 | 0.18 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 213.60 | 2.12 | 0.15 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 215.09 | 1.97 | 0.21 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 216.66 | 2.03 | 0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 218.24 | 2.10 | 0.15 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 219.78 | 2.01 | -0.15 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 221.30 | 2.20 | -0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 222.71 | 2.18 | -0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 223.89 | 2.33 | -0.10 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 224.98 | 2.57 | 0.15 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 225.96 | 2.61 | 0.05 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-11. November Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 6.412 | 3.569 | 1.4446 | 287.39 | 10.75 | 0.32 | 271.86 | 8.26 | -0.82 | 418. | 418. | 418. |
| 1.000 | 4.667 | 2.173 | 0.9720 | 284.74 | 6.99 | 0.24 | 268.19 | 6.44 | -0.39 | 538. | 538. | 538. |
| 1.007 | 4.653 | 2.165 | 0.9715 | 284.70 | 6.97 | 0.24 | 268.16 | 6.43 | -0.39 | 538. | 538. | 538. |
| 2.000 | 3.419 | 1.663 | 0.7052 | 279.29 | 5.16 | -0.11 | 263.97 | 6.69 | -0.35 | 538. | 538. | 538. |
| 3.000 | 2.208 | 1.298 | 0.6390 | 274.00 | 5.32 | -0.36 | 257.73 | 8.16 | -0.45 | 538. | 538. | 538. |
| 4.000 | 1.252 | 0.879 | 1.1099 | 268.19 | 5.46 | -0.62 | 250.52 | 8.45 | -0.12 | 538. | 538. | 538. |
| 5.000 | 0.765 | 0.600 | 1.2875 | 261.80 | 5.45 | -0.75 | 244.80 | 9.03 | -0.22 | 537. | 537. | 537. |
| 6.000 | 0.492 | 0.392 | 1.1137 | 254.89 | 5.50 | -0.80 | 239.30 | 9.66 | -0.37 | 536. | 536. | 536. |
| 7.000 | 0.283 | 0.229 | 1.2553 | 247.97 | 4.81 | -0.48 | 233.58 | 9.67 | -0.58 | 522. | 522. | 522. |
| 8.000 | 0.153 | 0.115 | 1.1488 | 241.34 | 3.77 | 0.04 | 227.92 | 9.24 | -0.82 | 471. | 471. | 471. |
| 9.000 | 0.094 | 0.054 | 0.6799 | 236.62 | 2.07 | 0.47 | 224.69 | 7.17 | -1.36 | 240. | 240. | 240. |
| 10.000 | 0.037 | 0.028 | 0.0100 | 235.60 | 2.37 | 1.09 | 215.50 | 3.46 | -0.31 | 11. | 11. | 11. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 220.91 | 3.98 | 0.60 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 216.99 | 4.95 | 0.36 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 214.79 | 4.85 | 0.11 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 212.86 | 4.30 | 0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 210.75 | 4.21 | 0.43 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 209.07 | 4.36 | 0.35 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 208.38 | 4.04 | -0.10 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 208.91 | 3.30 | -0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 210.12 | 2.61 | 0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 211.36 | 2.26 | -0.04 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 212.62 | 2.06 | -0.08 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 213.94 | 2.12 | -0.14 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 215.46 | 2.06 | -0.16 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 216.81 | 2.22 | 0.06 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 218.03 | 2.55 | 0.23 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 219.17 | 2.88 | 0.56 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 220.30 | 3.06 | 0.90 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 221.47 | 3.27 | 1.02 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 222.83 | 3.75 | 1.38 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 224.11 | 3.65 | 1.36 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-12. December Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 6.144 | 3.065 | 1.3231 | 284.07 | 10.60 | 0.09 | 271.86 | 6.69 | -0.13 | 473. | 473. | 472. |
| 1.000 | 4.472 | 1.843 | 0.6228 | 281.21 | 6.23 | 0.22 | 267.88 | 5.74 | -0.39 | 542. | 542. | 542. |
| 1.007 | 4.458 | 1.836 | 0.6237 | 281.18 | 6.22 | 0.22 | 267.85 | 5.74 | -0.39 | 542. | 542. | 542. |
| 2.000 | 3.205 | 1.650 | 0.5679 | 277.27 | 4.83 | -0.50 | 262.94 | 7.12 | -0.30 | 545. | 545. | 545. |
| 3.000 | 1.993 | 1.250 | 0.7923 | 272.78 | 5.48 | -0.82 | 256.26 | 8.45 | -0.34 | 545. | 545. | 545. |
| 4.000 | 1.171 | 0.881 | 1.0689 | 266.92 | 5.58 | -0.87 | 249.28 | 9.16 | -0.08 | 544. | 544. | 544. |
| 5.000 | 0.717 | 0.614 | 1.3809 | 260.53 | 5.41 | -0.97 | 243.19 | 9.73 | -0.06 | 543. | 543. | 543. |
| 6.000 | 0.456 | 0.393 | 1.4159 | 253.70 | 5.11 | -0.85 | 238.26 | 9.81 | -0.22 | 538. | 538. | 538. |
| 7.000 | 0.258 | 0.224 | 1.4863 | 246.59 | 4.61 | -0.41 | 232.43 | 9.80 | -0.44 | 529. | 529. | 529. |
| 8.000 | 0.143 | 0.111 | 1.4969 | 240.25 | 3.53 | 0.23 | 227.39 | 8.94 | -0.79 | 444. | 444. | 444. |
| 9.000 | 0.096 | 0.064 | 1.1117 | 236.39 | 2.24 | 0.23 | 224.65 | 7.47 | -1.01 | 162. | 162. | 162. |
| 10.000 | 0.041 | 0.026 | -0.2502 | 235.72 | 0.92 | -0.07 | 217.30 | 7.43 | -0.84 | 8. | 8. | 8. |
| 11.000 | 0.000 | 0.000 | 0.0000 | 219.58 | 4.36 | 0.70 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 216.46 | 5.14 | 0.40 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 214.80 | 5.26 | -0.03 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 213.47 | 4.49 | -0.10 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 211.54 | 4.06 | 0.09 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 209.75 | 4.00 | 0.09 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 208.77 | 3.89 | -0.10 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 208.57 | 3.60 | -0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 209.59 | 3.22 | 0.11 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 210.63 | 3.02 | 0.05 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 211.68 | 3.03 | 0.26 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 212.81 | 3.16 | 0.25 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 214.01 | 3.27 | 0.25 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 215.14 | 3.41 | 0.28 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 216.27 | 3.39 | 0.20 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 217.31 | 3.51 | 0.19 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 218.40 | 3.56 | 0.28 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 219.41 | 3.74 | 0.29 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 220.21 | 3.83 | 0.33 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 221.30 | 4.09 | 0.48 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

## TABLE C-13. Annual Moisture-Related Data, Nellis.

| Z KM | VP MEAN MB | S.D. VP MB | SKEW VP | TV MEAN K | TV S.D. K | SKEW TV K | TD MEAN K | S.D. TD K | SKEW TD | NOBS VP | NOBS TV | NOBS TD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0.000 | 8.523 | 5.530 | 1.6634 | 293.69 | 13.35 | 0.36 | 275.47 | 8.79 | -0.04 | 4409. | 4409. | 4407. |
| 1.000 | 6.107 | 3.381 | 1.6379 | 291.64 | 10.92 | 0.11 | 271.54 | 7.06 | 0.17 | 6099. | 6103. | 6098. |
| 1.007 | 6.095 | 3.366 | 1.6440 | 291.62 | 10.79 | 0.19 | 271.53 | 7.02 | 0.22 | 6099. | 6103. | 6101. |
| 2.000 | 4.544 | 2.509 | 1.1972 | 285.44 | 8.89 | -0.01 | 267.36 | 7.50 | -0.27 | 6164. | 6164. | 6164. |
| 3.000 | 3.201 | 2.037 | 1.0848 | 278.18 | 7.76 | -0.16 | 262.04 | 8.98 | -0.49 | 6158. | 6158. | 6158. |
| 4.000 | 1.940 | 1.546 | 1.3118 | 271.31 | 7.03 | -0.40 | 254.78 | 10.16 | -0.17 | 6155. | 6155. | 6155. |
| 5.000 | 1.088 | 1.030 | 1.7685 | 264.56 | 6.75 | -0.54 | 247.34 | 10.47 | 0.03 | 6152. | 6152. | 6152. |
| 6.000 | 0.591 | 0.589 | 2.1081 | 257.61 | 6.78 | -0.54 | 240.57 | 10.16 | -0.01 | 6130. | 6130. | 6130. |
| 7.000 | 0.314 | 0.305 | 2.2640 | 250.66 | 6.52 | -0.29 | 234.26 | 9.74 | -0.24 | 6018. | 6020. | 6020. |
| 8.000 | 0.177 | 0.164 | 2.2025 | 244.33 | 5.66 | 0.03 | 228.95 | 9.14 | -0.36 | 5391. | 5391. | 5391. |
| 9.000 | 0.107 | 0.089 | 1.8922 | 239.95 | 4.00 | 0.17 | 224.90 | 8.26 | -0.49 | 3515. | 3516. | 3516. |
| 10.000 | 0.067 | 0.053 | 1.1237 | 236.70 | 2.00 | 0.36 | 220.28 | 8.70 | -0.48 | 1343. | 1343. | 1343. |
| 11.000 | 0.036 | 0.038 | 1.1012 | 234.35 | 1.47 | 1.67 | 213.49 | 9.77 | 0.25 | 32. | 32. | 32. |
| 12.000 | 0.000 | 0.000 | 0.0000 | 218.26 | 5.08 | -0.21 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 13.000 | 0.000 | 0.000 | 0.0000 | 215.78 | 4.45 | -0.31 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 14.000 | 0.000 | 0.000 | 0.0000 | 213.73 | 4.09 | 0.11 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 15.000 | 0.000 | 0.000 | 0.0000 | 211.49 | 4.30 | 0.14 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 16.000 | 0.000 | 0.000 | 0.0000 | 209.84 | 4.39 | 0.10 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 17.000 | 0.000 | 0.000 | 0.0000 | 209.47 | 4.03 | 0.16 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 18.000 | 0.000 | 0.000 | 0.0000 | 210.16 | 3.50 | 0.07 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 19.000 | 0.000 | 0.000 | 0.0000 | 211.63 | 3.08 | -0.17 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 20.000 | 0.000 | 0.000 | 0.0000 | 213.11 | 2.96 | -0.44 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 21.000 | 0.000 | 0.000 | 0.0000 | 214.55 | 3.02 | -0.56 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 22.000 | 0.000 | 0.000 | 0.0000 | 215.99 | 3.19 | -0.60 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 23.000 | 0.000 | 0.000 | 0.0000 | 217.45 | 3.32 | -0.64 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 24.000 | 0.000 | 0.000 | 0.0000 | 218.93 | 3.53 | -0.63 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 25.000 | 0.000 | 0.000 | 0.0000 | 220.34 | 3.77 | -0.64 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 26.000 | 0.000 | 0.000 | 0.0000 | 221.83 | 3.99 | -0.55 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 27.000 | 0.000 | 0.000 | 0.0000 | 223.33 | 4.19 | -0.54 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 28.000 | 0.000 | 0.000 | 0.0000 | 224.75 | 4.41 | -0.50 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 29.000 | 0.000 | 0.000 | 0.0000 | 226.29 | 4.64 | -0.48 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |
| 30.000 | 0.000 | 0.000 | 0.0000 | 227.77 | 4.76 | -0.50 | 0.00 | 0.00 | 0.00 | 0. | 0. | 0. |

# APPENDIX D

## Nellis Hydrostatic Model Atmospheres

Tables D-1 through D-13 provide hydrostatic model atmospheres (monthly and annual) from 0 to 30 km over Nellis. They were prepared as described in Chapter 3.

## TABLE D-1. January Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D $G/M^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1019.6911 | 1247.0576 | 284.87 |
| 1.000 | 0.999 | 903.8348 | 1118.9778 | 281.40 |
| 1.007 | 1.006 | 902.9464 | 1117.7261 | 281.44 |
| 2.000 | 1.998 | 799.4678 | 1007.1643 | 276.54 |
| 3.000 | 2.998 | 705.8961 | 905.6743 | 271.54 |
| 4.000 | 3.997 | 621.2950 | 814.1843 | 265.85 |
| 5.000 | 4.996 | 545.5237 | 732.7905 | 259.35 |
| 6.000 | 5.995 | 477.5684 | 659.1123 | 252.43 |
| 7.000 | 6.994 | 416.2574 | 590.0635 | 245.77 |
| 8.000 | 7.994 | 361.2471 | 525.5449 | 239.47 |
| 9.000 | 8.993 | 312.2661 | 461.8239 | 235.56 |
| 10.000 | 9.992 | 268.5816 | 418.5371 | 223.56 |
| 11.000 | 10.991 | 230.1756 | 366.8352 | 218.60 |
| 12.000 | 11.990 | 196.7687 | 316.4070 | 216.65 |
| 13.000 | 12.989 | 168.0210 | 270.3268 | 216.54 |
| 14.000 | 13.989 | 143.4610 | 231.6576 | 215.75 |
| 15.000 | 14.988 | 122.2764 | 199.5017 | 213.53 |
| 16.000 | 15.987 | 104.1672 | 171.7847 | 211.25 |
| 17.000 | 16.986 | 88.5321 | 146.8132 | 210.08 |
| 18.000 | 17.985 | 75.2502 | 124.8951 | 209.90 |
| 19.000 | 18.985 | 63.9901 | 105.8417 | 210.63 |
| 20.000 | 19.984 | 54.4278 | 89.6402 | 211.53 |
| 21.000 | 20.983 | 46.3507 | 76.0090 | 212.45 |
| 22.000 | 21.982 | 39.5006 | 64.4515 | 213.51 |
| 23.000 | 22.981 | 33.6619 | 54.6711 | 214.51 |
| 24.000 | 23.980 | 28.7353 | 46.4428 | 215.55 |
| 25.000 | 24.980 | 24.5333 | 39.4787 | 216.50 |
| 26.000 | 25.979 | 20.9731 | 33.5568 | 217.74 |
| 27.000 | 26.978 | 17.9578 | 28.5784 | 218.91 |
| 28.000 | 27.977 | 15.3916 | 24.3565 | 220.15 |
| 29.000 | 28.976 | 13.2231 | 20.7987 | 221.49 |
| 30.000 | 29.976 | 11.3721 | 17.7416 | 223.31 |

## TABLE D-2. February Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D G/M$^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1018.3234 | 1243.9452 | 285.20 |
| 1.000 | 0.999 | 902.5216 | 1112.2462 | 282.69 |
| 1.007 | 1.006 | 901.6420 | 1110.4373 | 282.88 |
| 2.000 | 1.998 | 798.5957 | 1003.7957 | 277.17 |
| 3.000 | 2.998 | 705.2631 | 905.2783 | 271.41 |
| 4.000 | 3.997 | 620.6314 | 814.4531 | 265.48 |
| 5.000 | 4.996 | 544.8500 | 733.3273 | 258.84 |
| 6.000 | 5.995 | 476.8356 | 660.0758 | 251.67 |
| 7.000 | 6.994 | 415.4601 | 591.6090 | 244.65 |
| 8.000 | 7.994 | 360.3682 | 525.7939 | 238.77 |
| 9.000 | 8.993 | 311.2759 | 459.9731 | 235.76 |
| 10.000 | 9.992 | 267.4960 | 419.2778 | 222.27 |
| 11.000 | 10.991 | 228.9944 | 367.6283 | 217.01 |
| 12.000 | 11.990 | 195.5664 | 316.2338 | 215.45 |
| 13.000 | 12.989 | 166.8987 | 268.8568 | 216.27 |
| 14.000 | 13.989 | 142.4945 | 229.9877 | 215.85 |
| 15.000 | 14.988 | 121.4931 | 197.7596 | 214.03 |
| 16.000 | 15.987 | 103.5487 | 169.9918 | 212.21 |
| 17.000 | 16.986 | 88.1051 | 145.4971 | 210.96 |
| 18.000 | 17.985 | 74.9203 | 123.8950 | 210.67 |
| 19.000 | 18.985 | 63.7549 | 105.0207 | 211.49 |
| 20.000 | 19.984 | 54.2601 | 88.9940 | 212.41 |
| 21.000 | 20.983 | 46.2307 | 75.4728 | 213.40 |
| 22.000 | 21.982 | 39.4367 | 64.0307 | 214.57 |
| 23.000 | 22.981 | 33.6490 | 54.3514 | 215.68 |
| 24.000 | 23.980 | 28.7424 | 46.1789 | 216.84 |
| 25.000 | 24.980 | 24.5744 | 39.2826 | 217.94 |
| 26.000 | 25.979 | 21.0265 | 33.4086 | 219.26 |
| 27.000 | 26.978 | 18.0201 | 28.4777 | 220.45 |
| 28.000 | 27.977 | 15.4582 | 24.3015 | 221.61 |
| 29.000 | 28.976 | 13.2737 | 20.7450 | 222.91 |
| 30.000 | 29.976 | 11.3917 | 17.6969 | 224.26 |

## TABLE D-3. March Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D $G/M^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1014.1003 | 1234.5122 | 286.18 |
| 1.000 | 0.999 | 899.6005 | 1099.2907 | 285.10 |
| 1.007 | 1.006 | 898.7208 | 1098.0696 | 285.14 |
| 2.000 | 1.998 | 796.4112 | 997.6733 | 278.10 |
| 3.000 | 2.998 | 703.5070 | 905.5203 | 270.66 |
| 4.000 | 3.997 | 618.8408 | 815.7649 | 264.28 |
| 5.000 | 4.996 | 542.9363 | 734.0604 | 257.68 |
| 6.000 | 5.995 | 474.7878 | 660.1654 | 250.56 |
| 7.000 | 6.994 | 413.4389 | 591.8405 | 243.37 |
| 8.000 | 7.994 | 358.3957 | 524.8762 | 237.88 |
| 9.000 | 8.993 | 309.4311 | 459.7570 | 234.47 |
| 10.000 | 9.992 | 265.8379 | 416.9131 | 222.14 |
| 11.000 | 10.991 | 227.6374 | 363.9537 | 217.90 |
| 12.000 | 11.990 | 194.5518 | 312.6791 | 216.77 |
| 13.000 | 12.989 | 166.1705 | 266.6818 | 217.08 |
| 14.000 | 13.989 | 141.9560 | 228.2260 | 216.69 |
| 15.000 | 14.988 | 121.1234 | 196.2431 | 215.03 |
| 16.000 | 15.987 | 103.3121 | 168.7857 | 213.24 |
| 17.000 | 16.986 | 88.0147 | 144.4143 | 212.33 |
| 18.000 | 17.985 | 74.9237 | 123.1321 | 211.99 |
| 19.000 | 18.985 | 63.8132 | 104.6304 | 212.48 |
| 20.000 | 19.984 | 54.3510 | 88.8438 | 213.13 |
| 21.000 | 20.983 | 46.3375 | 75.4743 | 213.89 |
| 22.000 | 21.982 | 39.5204 | 64.1588 | 214.60 |
| 23.000 | 22.981 | 33.7133 | 54.4750 | 215.61 |
| 24.000 | 23.980 | 28.7851 | 46.2929 | 216.63 |
| 25.000 | 24.980 | 24.6073 | 39.3741 | 217.73 |
| 26.000 | 25.979 | 21.0497 | 33.4633 | 219.15 |
| 27.000 | 26.978 | 18.0509 | 28.4974 | 220.67 |
| 28.000 | 27.977 | 15.4821 | 24.2707 | 222.23 |
| 29.000 | 28.976 | 13.2918 | 20.6761 | 223.96 |
| 30.000 | 29.976 | 11.4034 | 17.5972 | 225.76 |

## TABLE D-4. April Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D G/M$^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1012.3194 | 1216.5879 | 289.89 |
| 1.000 | 0.999 | 899.0871 | 1082.6493 | 289.32 |
| 1.007 | 1.006 | 898.2267 | 1081.7562 | 289.28 |
| 2.000 | 1.998 | 797.2490 | 984.4452 | 282.14 |
| 3.000 | 2.998 | 705.4531 | 896.8954 | 274.02 |
| 4.000 | 3.997 | 621.4714 | 810.6966 | 267.07 |
| 5.000 | 4.996 | 546.0102 | 730.1463 | 260.52 |
| 6.000 | 5.995 | 478.2068 | 657.3891 | 253.43 |
| 7.000 | 6.994 | 417.0353 | 589.1108 | 246.62 |
| 8.000 | 7.994 | 362.1951 | 526.0147 | 239.88 |
| 9.000 | 8.993 | 313.3363 | 463.9979 | 235.26 |
| 10.000 | 9.992 | 269.6386 | 418.5951 | 224.41 |
| 11.000 | 10.991 | 231.1252 | 368.6620 | 218.41 |
| 12.000 | 11.990 | 197.4654 | 320.3438 | 214.75 |
| 13.000 | 12.989 | 168.3572 | 273.4150 | 214.52 |
| 14.000 | 13.989 | 143.5921 | 232.9848 | 214.71 |
| 15.000 | 14.988 | 122.3894 | 199.5366 | 213.59 |
| 16.000 | 15.987 | 104.2975 | 170.8206 | 212.71 |
| 17.000 | 16.986 | 88.8048 | 145.7564 | 212.26 |
| 18.000 | 17.985 | 75.5996 | 123.9944 | 212.41 |
| 19.000 | 18.985 | 64.4122 | 105.2721 | 213.16 |
| 20.000 | 19.984 | 54.8895 | 89.4035 | 213.89 |
| 21.000 | 20.983 | 46.8194 | 75.9392 | 214.79 |
| 22.000 | 21.982 | 39.9722 | 64.4807 | 215.97 |
| 23.000 | 22.981 | 34.1387 | 54.7288 | 217.31 |
| 24.000 | 23.980 | 29.1757 | 46.5170 | 218.51 |
| 25.000 | 24.980 | 24.9748 | 39.5296 | 220.11 |
| 26.000 | 25.979 | 21.3847 | 33.5935 | 221.77 |
| 27.000 | 26.978 | 18.3537 | 28.6195 | 223.42 |
| 28.000 | 27.977 | 15.7756 | 24.4125 | 225.13 |
| 29.000 | 28.976 | 13.5689 | 20.8230 | 227.02 |
| 30.000 | 29.976 | 11.6563 | 17.7463 | 228.83 |

## TABLE D-5. May Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D G/M$^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1008.0833 | 1184.3793 | 296.53 |
| 1.000 | 0.999 | 897.4384 | 1059.6443 | 295.05 |
| 1.007 | 1.006 | 896.6083 | 1058.8662 | 295.00 |
| 2.000 | 1.998 | 797.6146 | 965.5542 | 287.79 |
| 3.000 | 2.998 | 707.4376 | 882.7571 | 279.19 |
| 4.000 | 3.997 | 624.6033 | 801.6915 | 271.43 |
| 5.000 | 4.996 | 549.8811 | 724.2132 | 264.52 |
| 6.000 | 5.995 | 482.6646 | 653.0340 | 257.49 |
| 7.000 | 6.994 | 421.8314 | 587.1521 | 250.29 |
| 8.000 | 7.994 | 367.1010 | 525.8607 | 243.20 |
| 9.000 | 8.993 | 318.2796 | 467.5562 | 237.16 |
| 10.000 | 9.992 | 274.6053 | 407.8883 | 234.54 |
| 11.000 | 10.991 | 235.8472 | 371.7148 | 221.04 |
| 12.000 | 11.990 | 201.7642 | 324.9630 | 216.31 |
| 13.000 | 12.989 | 172.1448 | 279.7353 | 214.39 |
| 14.000 | 13.989 | 146.8094 | 238.7670 | 214.21 |
| 15.000 | 14.988 | 125.0848 | 204.0045 | 213.61 |
| 16.000 | 15.987 | 106.5718 | 174.7362 | 212.48 |
| 17.000 | 16.986 | 90.7838 | 149.2434 | 211.92 |
| 18.000 | 17.985 | 77.2700 | 126.9966 | 211.97 |
| 19.000 | 18.985 | 65.7982 | 107.7329 | 212.78 |
| 20.000 | 19.984 | 56.0727 | 91.2556 | 214.07 |
| 21.000 | 20.983 | 47.8379 | 77.2471 | 215.75 |
| 22.000 | 21.982 | 40.8919 | 65.5325 | 217.39 |
| 23.000 | 22.981 | 34.9612 | 55.5883 | 219.11 |
| 24.000 | 23.980 | 29.9119 | 47.1828 | 220.86 |
| 25.000 | 24.980 | 25.6553 | 40.1611 | 222.55 |
| 26.000 | 25.979 | 22.0105 | 34.1768 | 224.37 |
| 27.000 | 26.978 | 18.9113 | 29.1298 | 226.17 |
| 28.000 | 27.977 | 16.2751 | 24.8713 | 227.97 |
| 29.000 | 28.976 | 14.0182 | 21.2539 | 229.78 |
| 30.000 | 29.976 | 12.0721 | 18.1605 | 231.59 |

## TABLE D-6. June Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D $G/M^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1006.6837 | 1161.1521 | 302.04 |
| 1.000 | 0.999 | 898.1988 | 1041.5760 | 300.43 |
| 1.007 | 1.006 | 897.2213 | 1040.6753 | 300.36 |
| 2.000 | 1.998 | 800.0531 | 949.8742 | 293.43 |
| 3.000 | 2.998 | 711.2185 | 870.1947 | 284.74 |
| 4.000 | 3.997 | 629.3964 | 792.2160 | 276.78 |
| 5.000 | 4.996 | 555.4234 | 718.0855 | 269.47 |
| 6.000 | 5.995 | 488.9012 | 649.1309 | 262.39 |
| 7.000 | 6.994 | 428.2306 | 584.8147 | 255.10 |
| 8.000 | 7.994 | 373.7435 | 525.9165 | 247.58 |
| 9.000 | 8.993 | 324.8088 | 471.2259 | 240.14 |
| 10.000 | 9.992 | 281.2709 | 416.6161 | 235.20 |
| 11.000 | 10.991 | 242.2629 | 374.8826 | 225.14 |
| 12.000 | 11.990 | 207.6807 | 330.0125 | 219.24 |
| 13.000 | 12.989 | 177.4817 | 286.9051 | 215.51 |
| 14.000 | 13.989 | 151.3882 | 247.1056 | 213.44 |
| 15.000 | 14.988 | 128.8479 | 212.2853 | 211.45 |
| 16.000 | 15.987 | 109.5733 | 181.8661 | 209.90 |
| 17.000 | 16.986 | 93.1668 | 155.1943 | 209.14 |
| 18.000 | 17.985 | 79.1620 | 131.2444 | 210.13 |
| 19.000 | 18.985 | 67.3519 | 110.5375 | 212.27 |
| 20.000 | 19.984 | 57.4012 | 93.2819 | 214.38 |
| 21.000 | 20.983 | 48.9731 | 78.8760 | 216.31 |
| 22.000 | 21.982 | 41.8829 | 66.8799 | 218.17 |
| 23.000 | 22.981 | 35.8301 | 56.7412 | 219.99 |
| 24.000 | 23.980 | 30.6673 | 48.1623 | 221.83 |
| 25.000 | 24.980 | 26.3306 | 40.9940 | 223.77 |
| 26.000 | 25.979 | 22.6128 | 34.9262 | 225.56 |
| 27.000 | 26.978 | 19.4477 | 29.8008 | 227.35 |
| 28.000 | 27.977 | 16.7487 | 25.4732 | 229.06 |
| 29.000 | 28.976 | 14.4360 | 21.7920 | 230.78 |
| 30.000 | 29.976 | 12.4491 | 18.6533 | 232.51 |

## TABLE D-7. July Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D $G/M^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1006.9894 | 1146.6211 | 305.96 |
| 1.000 | 0.999 | 899.8860 | 1032.6690 | 303.59 |
| 1.007 | 1.006 | 899.0186 | 1031.8735 | 303.53 |
| 2.000 | 1.998 | 802.5696 | 942.8218 | 296.56 |
| 3.000 | 2.998 | 714.2866 | 864.2921 | 287.92 |
| 4.000 | 3.997 | 633.0849 | 788.1207 | 279.85 |
| 5.000 | 4.996 | 559.4796 | 715.3792 | 272.46 |
| 6.000 | 5.995 | 493.1648 | 647.0621 | 265.52 |
| 7.000 | 6.994 | 432.6713 | 582.7907 | 258.64 |
| 8.000 | 7.994 | 378.4316 | 524.2049 | 251.50 |
| 9.000 | 8.993 | 329.5564 | 470.3848 | 244.08 |
| 10.000 | 9.992 | 286.2106 | 420.4005 | 237.18 |
| 11.000 | 10.991 | 247.2235 | 366.6635 | 234.90 |
| 12.000 | 11.990 | 212.3934 | 332.3269 | 222.66 |
| 13.000 | 12.989 | 181.7977 | 292.2481 | 216.72 |
| 14.000 | 13.989 | 155.0642 | 255.3969 | 211.52 |
| 15.000 | 14.988 | 131.7455 | 220.8968 | 207.78 |
| 16.000 | 15.987 | 111.7269 | 188.6073 | 206.37 |
| 17.000 | 16.986 | 94.7599 | 159.3123 | 207.22 |
| 18.000 | 17.985 | 80.4339 | 133.9051 | 209.27 |
| 19.000 | 18.985 | 68.4010 | 112.3641 | 212.08 |
| 20.000 | 19.984 | 58.3066 | 94.6494 | 214.61 |
| 21.000 | 20.983 | 49.7421 | 79.9455 | 216.76 |
| 22.000 | 21.982 | 42.5618 | 67.7839 | 218.75 |
| 23.000 | 22.981 | 36.4312 | 57.5606 | 220.50 |
| 24.000 | 23.980 | 31.1966 | 48.9191 | 222.17 |
| 25.000 | 24.980 | 26.7799 | 41.6672 | 223.91 |
| 26.000 | 25.979 | 23.0044 | 35.5168 | 225.65 |
| 27.000 | 26.978 | 19.7818 | 30.3124 | 227.35 |
| 28.000 | 27.977 | 17.0402 | 25.9294 | 228.95 |
| 29.000 | 28.976 | 14.6904 | 22.1944 | 230.59 |
| 30.000 | 29.976 | 12.6614 | 19.0055 | 232.09 |

## TABLE D-8. August Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D G/M$^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1008.0256 | 1146.8692 | 306.21 |
| 1.000 | 0.999 | 900.7066 | 1035.4380 | 303.05 |
| 1.007 | 1.006 | 899.3405 | 1034.1990 | 302.95 |
| 2.000 | 1.998 | 803.1205 | 945.0663 | 296.06 |
| 3.000 | 2.998 | 714.6033 | 866.3698 | 287.36 |
| 4.000 | 3.997 | 633.2090 | 789.8457 | 279.29 |
| 5.000 | 4.996 | 559.4481 | 716.5457 | 272.00 |
| 6.000 | 5.995 | 493.0628 | 647.8027 | 265.17 |
| 7.000 | 6.994 | 432.5181 | 583.4286 | 258.27 |
| 8.000 | 7.994 | 378.2118 | 524.8839 | 251.03 |
| 9.000 | 8.993 | 329.2825 | 471.0719 | 243.52 |
| 10.000 | 9.992 | 285.8239 | 419.7316 | 237.24 |
| 11.000 | 10.991 | 246.8184 | 367.3992 | 234.04 |
| 12.000 | 11.990 | 212.0242 | 332.0527 | 222.45 |
| 13.000 | 12.989 | 181.4692 | 291.6414 | 216.78 |
| 14.000 | 13.989 | 154.8157 | 254.5427 | 211.89 |
| 15.000 | 14.988 | 131.5719 | 220.0784 | 208.28 |
| 16.000 | 15.987 | 111.6117 | 188.1680 | 206.64 |
| 17.000 | 16.986 | 94.6452 | 158.8516 | 207.57 |
| 18.000 | 17.985 | 80.3675 | 133.4613 | 209.79 |
| 19.000 | 18.985 | 68.3627 | 112.0674 | 212.52 |
| 20.000 | 19.984 | 58.2859 | 94.5409 | 214.78 |
| 21.000 | 20.983 | 49.7345 | 79.9221 | 216.79 |
| 22.000 | 21.982 | 42.5500 | 67.8552 | 218.46 |
| 23.000 | 22.981 | 36.4130 | 57.6435 | 220.07 |
| 24.000 | 23.980 | 31.1710 | 48.9802 | 221.71 |
| 25.000 | 24.980 | 26.7447 | 41.7292 | 223.28 |
| 26.000 | 25.979 | 22.9642 | 35.5748 | 224.89 |
| 27.000 | 26.978 | 19.7387 | 30.3779 | 226.37 |
| 28.000 | 27.977 | 16.9860 | 25.9889 | 227.70 |
| 29.000 | 28.976 | 14.6274 | 22.2523 | 229.01 |
| 30.000 | 29.976 | 12.5972 | 19.0570 | 230.29 |

## TABLE D-9. September Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D G/M$^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1009.2957 | 1166.0282 | 301.56 |
| 1.000 | 0.999 | 900.2221 | 1049.8397 | 298.73 |
| 1.007 | 1.006 | 898.8437 | 1048.5662 | 298.64 |
| 2.000 | 1.998 | 801.2171 | 956.7482 | 291.75 |
| 3.000 | 2.998 | 711.7420 | 875.6017 | 283.19 |
| 4.000 | 3.997 | 629.6457 | 795.4797 | 275.76 |
| 5.000 | 4.996 | 555.4503 | 719.1750 | 269.07 |
| 6.000 | 5.995 | 488.7572 | 648.8648 | 262.42 |
| 7.000 | 6.994 | 428.1639 | 584.0953 | 255.38 |
| 8.000 | 7.994 | 373.7450 | 524.9625 | 248.03 |
| 9.000 | 8.993 | 324.8991 | 470.1563 | 240.75 |
| 10.000 | 9.992 | 281.4709 | 414.8507 | 236.37 |
| 11.000 | 10.991 | 242.6273 | 360.9504 | 234.18 |
| 12.000 | 11.990 | 208.2034 | 328.3513 | 220.91 |
| 13.000 | 12.989 | 178.0319 | 286.5911 | 216.42 |
| 14.000 | 13.989 | 151.9224 | 248.7243 | 212.79 |
| 15.000 | 14.988 | 129.1737 | 214.6883 | 209.62 |
| 16.000 | 15.987 | 109.6878 | 183.9818 | 207.70 |
| 17.000 | 16.986 | 93.0949 | 155.9733 | 207.94 |
| 18.000 | 17.985 | 79.0498 | 131.3103 | 209.73 |
| 19.000 | 18.985 | 67.2306 | 110.5251 | 211.92 |
| 20.000 | 19.984 | 57.2821 | 93.2350 | 214.04 |
| 21.000 | 20.983 | 48.8543 | 78.8231 | 215.93 |
| 22.000 | 21.982 | 41.7662 | 66.8686 | 217.60 |
| 23.000 | 22.981 | 35.7178 | 56.7526 | 219.26 |
| 24.000 | 23.980 | 30.5643 | 48.1943 | 220.94 |
| 25.000 | 24.980 | 26.2088 | 41.0554 | 222.40 |
| 26.000 | 25.979 | 22.4885 | 35.0040 | 223.82 |
| 27.000 | 26.978 | 19.3049 | 29.8743 | 225.13 |
| 28.000 | 27.977 | 16.6037 | 25.5619 | 226.29 |
| 29.000 | 28.976 | 14.2857 | 21.8824 | 227.44 |
| 30.000 | 29.976 | 12.2905 | 18.7429 | 228.45 |

## TABLE D-10. October Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D G/M$^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1014.2491 | 1203.8255 | 293.52 |
| 1.000 | 0.999 | 901.8252 | 1076.6443 | 291.82 |
| 1.007 | 1.006 | 900.7736 | 1075.3767 | 291.82 |
| 2.000 | 1.998 | 800.8971 | 976.3585 | 285.78 |
| 3.000 | 2.998 | 709.7579 | 889.2044 | 278.08 |
| 4.000 | 3.997 | 626.6097 | 803.1901 | 271.79 |
| 5.000 | 4.996 | 551.7638 | 723.9950 | 265.51 |
| 6.000 | 5.995 | 484.6218 | 652.7419 | 258.65 |
| 7.000 | 6.994 | 423.7357 | 587.2407 | 251.38 |
| 8.000 | 7.994 | 369.0244 | 526.6910 | 244.09 |
| 9.000 | 8.993 | 320.1422 | 469.4467 | 237.58 |
| 10.000 | 9.992 | 276.5477 | 409.4996 | 235.27 |
| 11.000 | 10.991 | 237.8449 | 371.2359 | 223.20 |
| 12.000 | 11.990 | 203.7985 | 324.5490 | 218.77 |
| 13.000 | 12.989 | 174.0470 | 281.4329 | 215.45 |
| 14.000 | 13.989 | 148.4669 | 243.0232 | 212.83 |
| 15.000 | 14.988 | 126.2364 | 209.1241 | 210.30 |
| 16.000 | 15.987 | 107.2599 | 179.1766 | 208.55 |
| 17.000 | 16.986 | 91.0983 | 152.4235 | 208.22 |
| 18.000 | 17.985 | 77.3449 | 128.7821 | 209.23 |
| 19.000 | 18.985 | 65.7581 | 108.7266 | 210.70 |
| 20.000 | 19.984 | 55.9465 | 91.8350 | 212.24 |
| 21.000 | 20.983 | 47.6575 | 77.7309 | 213.60 |
| 22.000 | 21.982 | 40.6562 | 65.8509 | 215.09 |
| 23.000 | 22.981 | 34.7005 | 55.7965 | 216.66 |
| 24.000 | 23.980 | 29.6536 | 47.3361 | 218.24 |
| 25.000 | 24.980 | 25.3839 | 40.2375 | 219.78 |
| 26.000 | 25.979 | 21.7379 | 34.2211 | 221.30 |
| 27.000 | 26.978 | 18.6513 | 29.1759 | 222.71 |
| 28.000 | 27.977 | 16.0101 | 24.9120 | 223.89 |
| 29.000 | 28.976 | 13.7560 | 21.3013 | 224.98 |
| 30.000 | 29.976 | 11.8188 | 18.2217 | 225.96 |

## TABLE D-11. November Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D $G/M^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1016.9615 | 1232.7749 | 287.39 |
| 1.000 | 0.999 | 902.4134 | 1104.1156 | 284.74 |
| 1.007 | 1.006 | 901.5385 | 1103.1906 | 284.70 |
| 2.000 | 1.998 | 799.2332 | 996.9408 | 279.29 |
| 3.000 | 2.998 | 706.5717 | 898.3767 | 274.00 |
| 4.000 | 3.997 | 622.6450 | 808.8348 | 268.19 |
| 5.000 | 4.996 | 547.3289 | 728.3519 | 261.80 |
| 6.000 | 5.995 | 479.7301 | 655.6903 | 254.89 |
| 7.000 | 6.994 | 418.7028 | 588.2539 | 247.97 |
| 8.000 | 7.994 | 363.9607 | 525.3920 | 241.34 |
| 9.000 | 8.993 | 315.1610 | 464.0317 | 236.62 |
| 10.000 | 9.992 | 271.6761 | 401.7311 | 235.60 |
| 11.000 | 10.991 | 233.2205 | 367.7897 | 220.91 |
| 12.000 | 11.990 | 199.5720 | 320.4118 | 216.99 |
| 13.000 | 12.989 | 170.3047 | 276.2335 | 214.79 |
| 14.000 | 13.989 | 145.2022 | 237.6543 | 212.86 |
| 15.000 | 14.988 | 123.5004 | 204.1565 | 210.75 |
| 16.000 | 15.987 | 104.9845 | 174.9391 | 209.07 |
| 17.000 | 16.986 | 89.1897 | 149.1142 | 208.38 |
| 18.000 | 17.985 | 75.7186 | 126.2724 | 208.91 |
| 19.000 | 18.985 | 64.3465 | 106.6878 | 210.12 |
| 20.000 | 19.984 | 54.7176 | 90.1902 | 211.36 |
| 21.000 | 20.983 | 46.5923 | 76.3442 | 212.62 |
| 22.000 | 21.982 | 39.7130 | 64.6696 | 213.94 |
| 23.000 | 22.981 | 33.8698 | 54.7661 | 215.46 |
| 24.000 | 23.980 | 28.9123 | 46.4571 | 216.81 |
| 25.000 | 24.980 | 24.7167 | 39.4942 | 218.03 |
| 26.000 | 25.979 | 21.1346 | 33.5939 | 219.17 |
| 27.000 | 26.978 | 18.1104 | 28.6402 | 220.30 |
| 28.000 | 27.977 | 15.5205 | 24.4150 | 221.47 |
| 29.000 | 28.976 | 13.3119 | 20.8122 | 222.83 |
| 30.000 | 29.976 | 11.4296 | 17.7675 | 224.11 |

## TABLE D-12. December Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D G/M$^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1020.4846 | 1251.5015 | 284.07 |
| 1.000 | 0.999 | 904.1017 | 1120.0529 | 281.21 |
| 1.007 | 1.006 | 903.2093 | 1119.0651 | 281.18 |
| 2.000 | 1.998 | 799.8099 | 1004.9454 | 277.27 |
| 3.000 | 2.998 | 706.5395 | 902.3788 | 272.78 |
| 4.000 | 3.997 | 622.1421 | 812.0096 | 266.92 |
| 5.000 | 4.996 | 546.5886 | 730.9006 | 260.53 |
| 6.000 | 5.995 | 478.8665 | 657.5896 | 253.70 |
| 7.000 | 6.994 | 417.6487 | 590.0478 | 246.59 |
| 8.000 | 7.994 | 362.7275 | 525.9792 | 240.25 |
| 9.000 | 8.993 | 313.8119 | 462.4806 | 236.39 |
| 10.000 | 9.992 | 270.1600 | 399.2758 | 235.72 |
| 11.000 | 10.991 | 231.7293 | 367.6570 | 219.58 |
| 12.000 | 11.990 | 198.1620 | 318.9286 | 216.46 |
| 13.000 | 12.989 | 169.0795 | 274.2309 | 214.80 |
| 14.000 | 13.989 | 144.1816 | 235.3062 | 213.47 |
| 15.000 | 14.988 | 122.6979 | 202.0742 | 211.54 |
| 16.000 | 15.987 | 104.3687 | 173.3510 | 209.75 |
| 17.000 | 16.986 | 88.6658 | 147.9595 | 208.77 |
| 18.000 | 17.985 | 75.2648 | 125.7152 | 208.57 |
| 19.000 | 18.985 | 63.9383 | 106.2816 | 209.59 |
| 20.000 | 19.984 | 54.3407 | 89.8810 | 210.63 |
| 21.000 | 20.983 | 46.2538 | 76.1238 | 211.68 |
| 22.000 | 21.982 | 39.3981 | 64.4978 | 212.81 |
| 23.000 | 22.981 | 33.5697 | 54.6475 | 214.01 |
| 24.000 | 23.980 | 28.6339 | 46.3677 | 215.14 |
| 25.000 | 24.980 | 24.4481 | 39.3823 | 216.27 |
| 26.000 | 25.979 | 20.8760 | 33.4680 | 217.31 |
| 27.000 | 26.978 | 17.8730 | 28.5104 | 218.40 |
| 28.000 | 27.977 | 15.3027 | 24.2982 | 219.41 |
| 29.000 | 28.976 | 13.1067 | 20.7354 | 220.21 |
| 30.000 | 29.976 | 11.2139 | 17.6536 | 221.30 |

## TABLE D-13. Annual Hydrostatic Model Atmosphere, Nellis.

| Z KM | GEO. HT KM | PRESS MB | D $G/M^3$ | TV K |
|---|---|---|---|---|
| 0.000 | 0.000 | 1013.1313 | 1201.7952 | 293.69 |
| 1.000 | 0.999 | 900.8420 | 1076.1218 | 291.64 |
| 1.007 | 1.006 | 899.8594 | 1075.0252 | 291.62 |
| 2.000 | 1.998 | 799.7914 | 976.1532 | 285.44 |
| 3.000 | 2.998 | 708.6985 | 887.5602 | 278.18 |
| 4.000 | 3.997 | 625.5273 | 803.2364 | 271.31 |
| 5.000 | 4.996 | 550.6571 | 725.1383 | 264.56 |
| 6.000 | 5.995 | 483.3957 | 653.7187 | 257.61 |
| 7.000 | 6.994 | 422.4560 | 587.1582 | 250.66 |
| 8.000 | 7.994 | 367.7538 | 524.3619 | 244.33 |
| 9.000 | 8.993 | 318.8478 | 462.9279 | 239.95 |
| 10.000 | 9.992 | 275.2841 | 405.1813 | 236.70 |
| 11.000 | 10.991 | 236.6350 | 351.7864 | 234.35 |
| 12.000 | 11.990 | 202.6529 | 323.4745 | 218.26 |
| 13.000 | 12.989 | 173.1004 | 279.4796 | 215.78 |
| 14.000 | 13.989 | 147.6945 | 240.7392 | 213.73 |
| 15.000 | 14.988 | 125.7097 | 207.0820 | 211.49 |
| 16.000 | 15.987 | 106.9148 | 177.4998 | 209.84 |
| 17.000 | 16.986 | 90.8507 | 151.1015 | 209.47 |
| 18.000 | 17.985 | 77.1980 | 127.9713 | 210.16 |
| 19.000 | 18.985 | 65.6818 | 108.1246 | 211.63 |
| 20.000 | 19.984 | 55.9307 | 91.4332 | 213.11 |
| 21.000 | 20.983 | 47.6888 | 77.4350 | 214.55 |
| 22.000 | 21.982 | 40.7273 | 65.6911 | 215.99 |
| 23.000 | 22.981 | 34.7877 | 55.7337 | 217.45 |
| 24.000 | 23.980 | 29.7521 | 47.3449 | 218.93 |
| 25.000 | 24.980 | 25.4707 | 40.2724 | 220.34 |
| 26.000 | 25.979 | 21.8263 | 34.2783 | 221.83 |
| 27.000 | 26.978 | 18.7469 | 29.2439 | 223.33 |
| 28.000 | 27.977 | 16.1135 | 24.9775 | 224.75 |
| 29.000 | 28.976 | 13.8767 | 21.3636 | 226.29 |
| 30.000 | 29.976 | 11.9407 | 18.2637 | 227.77 |

# APPENDIX E

## Wind Statistics Derivable from Appendix A Tables

Appendix E gives a few graphic examples of certain wind statistics that can be derived from basic data in Appendix A. These examples should help RRA users understand the functional relationships of the probability wind models and develop an appreciation for the powerful properties of the bivariate normal probability distribution function. Only a few of the many options in deriving wind statistics are illustrated here.

All illustrations for this appendix were derived for the five wind component statistical parameters from Table A-1 (January) and Table A-7 (July) for nine selected altitudes; these are: 2, 4, 8, 12, 16, 20, 24, 28, and 30 km. Descriptions of Tables E-1 and E-2 and Figures E-1 through E-72 follow:

**Wind Speed (Tables E-1 and E-2)**

The five wind components from Appendix A are used as inputs to the generalized Rayleigh probability density function (equation 29), then integrated as indicated by equation 30 to obtain the probability distribution function for wind speed. The derived distribution functions for wind speed are shown in Tables E-1 and E-2 on the normal probability scale.

**Frequency of Wind Direction (Figures E-1 through E-18)**

The derived frequencies for wind direction shown in Figures E-5 through E-20 were obtained using the five wind component parameters from Tables A-1 and A-7 as input values in equation 35. The limits of integration (performed numerically) are over the 22.5-degree interval for each of the 16 compass points. The graphs give the percentage frequency that the wind will blow from the direction intervals.

**Mean Wind Components and 80th Interpercentile Range of Wind Components (Figures E-19 through E-36)**

Wind component means with respect to any orthogonal axis are obtained by using the zonal and meridional mean wind components in equations 44 and 45. These component means form the circle shown in Figures E-19 through E-36. The zonal and meridional wind component variances and correlation coefficients are then used in equations 46 and 47 to obtain the variances with respect to any orthogonal axis. These rotated component variances and the rotated component means are used in equation 8 to obtain the 80th interpercentile range of wind components, as shown in Figures E-19 through E-36.

**Probability Ellipses (Figures E-37 through E-54)**

Using the five wind component parameters from Tables A-1 and A-7, and $p = 0.50$, $p = 0.95$, and $p = 0.99$ as input values to equation 13, the wind probability ellipses shown in Figures E-37 through E-54 were produced with computer graphics, using the standard meteorological coordinate system explained in Chapter 1. Statistical inferences are, for example, that 50 percent of the wind vectors lie within the smaller ellipse, and that 99 percent lie within the outer ellipse.

**Conditional Wind Speed Given Wind Direction (Figures E-55 through E-72)**

The five wind component parameters from Tables A-1 and A-7 were used to evaluate the conditional probability distribution function, equation 41. Interpolations of the conditional function are made to obtain the 5th, 15th, 50th (median), 85th, 95th, and 99th conditional percentile values of wind speed, given wind directions, are as shown in Figures E-55 through E-72. The conditional mean wind speed, given wind direction, is obtained from equation 40. The conditional mode (most probable) wind speed given wind direction is obtained from equation 38. The conditional mean wind speed and the conditional wind speed modal value, given the wind direction, are also shown. For some figures, conditional wind speed values are invalid for a given wind direction near 270 degrees (from the west); this is caused by the lack of computational precision in evaluating equations 40 and 41 when arguments for the Gaussian probability distribution have large negative values; i.e., when the coefficients (b/a) become less than -4 in these equations.

## TABLE E-1. Derived (Rayleigh) Percentiles for Windspeed (M/S), January.

| | ALTITUDE (KM) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PERCENTILE | 2 KM | 4 KM | 8 KM | 12 KM | 16 KM | 20 KM | 24 KM | 28 KM | 30 KM |
| 0.010 | 0.720 | 1.396 | 2.745 | 3.521 | 2.746 | 1.014 | 1.242 | 1.768 | 2.036 |
| 0.025 | 1.140 | 2.211 | 4.357 | 5.534 | 4.270 | 1.608 | 1.972 | 2.810 | 3.232 |
| 0.050 | 1.624 | 3.142 | 6.177 | 7.789 | 5.914 | 2.281 | 2.795 | 4.018 | 4.624 |
| 0.100 | 2.335 | 4.492 | 8.791 | 10.936 | 8.109 | 3.257 | 3.991 | 5.786 | 6.669 |
| 0.150 | 2.912 | 5.574 | 10.861 | 13.341 | 9.708 | 4.030 | 4.943 | 7.222 | 8.332 |
| 0.200 | 3.431 | 6.523 | 12.669 | 15.379 | 11.032 | 4.708 | 5.779 | 8.497 | 9.826 |
| 0.300 | 4.384 | 8.216 | 15.867 | 18.899 | 13.250 | 5.922 | 7.285 | 10.853 | 12.605 |
| 0.400 | 5.313 | 9.799 | 18.808 | 22.058 | 15.200 | 7.058 | 8.716 | 13.154 | 15.351 |
| 0.500 | 6.281 | 11.372 | 21.705 | 25.109 | 17.054 | 8.198 | 10.184 | 15.573 | 18.270 |
| 0.600 | 7.352 | 13.025 | 24.718 | 28.238 | 18.934 | 9.413 | 11.788 | 18.272 | 21.572 |
| 0.700 | 8.616 | 14.867 | 28.046 | 31.662 | 20.971 | 10.796 | 13.675 | 21.508 | 25.547 |
| 0.800 | 10.253 | 17.106 | 32.040 | 35.747 | 23.382 | 12.531 | 16.131 | 25.718 | 30.728 |
| 0.850 | 11.335 | 18.519 | 34.553 | 38.305 | 24.870 | 13.655 | 17.761 | 28.513 | 34.161 |
| 0.900 | 12.768 | 20.338 | 37.757 | 41.565 | 26.757 | 15.134 | 19.936 | 32.203 | 38.650 |
| 0.950 | 15.013 | 23.131 | 42.641 | 46.522 | 29.563 | 17.448 | 23.355 | 37.943 | 45.659 |
| 0.975 | 17.057 | 25.645 | 46.976 | 50.926 | 32.040 | 19.553 | 26.473 | 43.111 | 51.949 |
| 0.990 | 19.512 | 28.625 | 52.217 | 56.289 | 34.917 | 22.076 | 30.218 | 49.224 | 59.343 |

## TABLE E-2. Derived (Rayleigh) Percentiles for Windspeed (M/S), July.

| | ALTITUDE (KM) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| PERCENTILE | 2 KM | 4 KM | 8 KM | 12 KM | 16 KM | 20 KM | 24 KM | 28 KM | 30 KM |
| 0.010 | 0.668 | 0.803 | 1.494 | 2.481 | 0.992 | 1.828 | 6.273 | 8.928 | 9.578 |
| 0.025 | 1.065 | 1.272 | 2.365 | 3.904 | 1.574 | 2.485 | 7.136 | 9.896 | 10.686 |
| 0.050 | 1.522 | 1.808 | 3.361 | 5.528 | 2.241 | 3.080 | 7.884 | 10.713 | 11.632 |
| 0.100 | 2.206 | 2.589 | 4.805 | 7.845 | 3.210 | 3.796 | 8.750 | 11.670 | 12.725 |
| 0.150 | 2.768 | 3.211 | 5.953 | 9.642 | 3.985 | 4.293 | 9.337 | 12.318 | 13.470 |
| 0.200 | 3.277 | 3.759 | 6.962 | 11.193 | 4.667 | 4.692 | 9.807 | 12.835 | 14.063 |
| 0.300 | 4.229 | 4.744 | 8.770 | 13.898 | 5.895 | 5.348 | 10.570 | 13.676 | 15.029 |
| 0.400 | 5.155 | 5.668 | 10.457 | 16.361 | 7.045 | 5.916 | 11.221 | 14.392 | 15.851 |
| 0.500 | 6.102 | 6.593 | 12.131 | 18.747 | 8.194 | 6.453 | 11.832 | 15.066 | 16.625 |
| 0.600 | 7.103 | 7.571 | 13.883 | 21.196 | 9.407 | 6.994 | 12.442 | 15.736 | 17.399 |
| 0.700 | 8.212 | 8.670 | 15.828 | 23.874 | 10.760 | 7.578 | 13.095 | 16.456 | 18.226 |
| 0.800 | 9.543 | 10.017 | 18.178 | 27.059 | 12.406 | 8.269 | 13.863 | 17.302 | 19.200 |
| 0.850 | 10.369 | 10.873 | 19.650 | 29.034 | 13.441 | 8.695 | 14.334 | 17.821 | 19.796 |
| 0.900 | 11.415 | 11.974 | 21.523 | 31.540 | 14.762 | 9.233 | 14.926 | 18.472 | 20.544 |
| 0.950 | 12.974 | 13.654 | 24.339 | 35.276 | 16.765 | 10.037 | 15.799 | 19.430 | 21.655 |
| 0.975 | 14.337 | 15.155 | 26.837 | 38.581 | 18.541 | 10.751 | 16.565 | 20.270 | 22.625 |
| 0.990 | 15.957 | 16.956 | 29.819 | 42.461 | 20.628 | 11.602 | 17.464 | 21.262 | 23.777 |

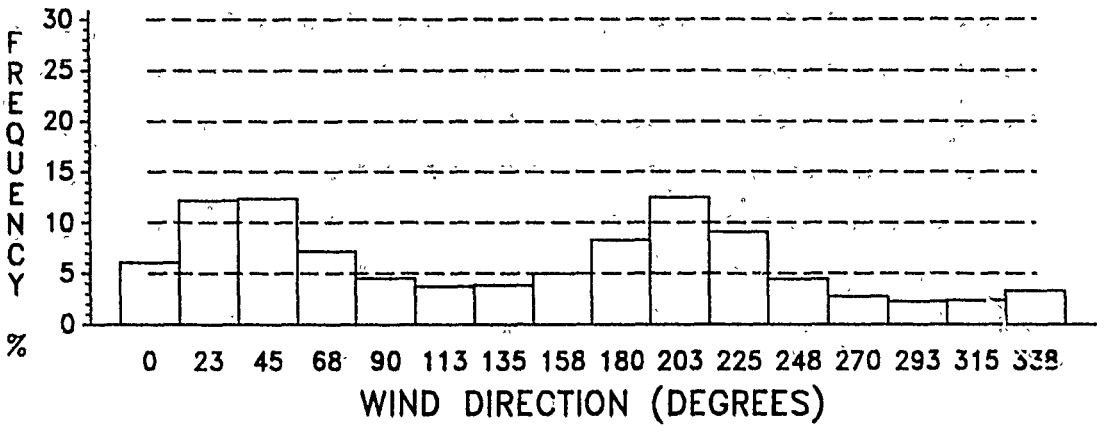


**Figure E-1. Wind Direction Frequency, January, 2 KM.**

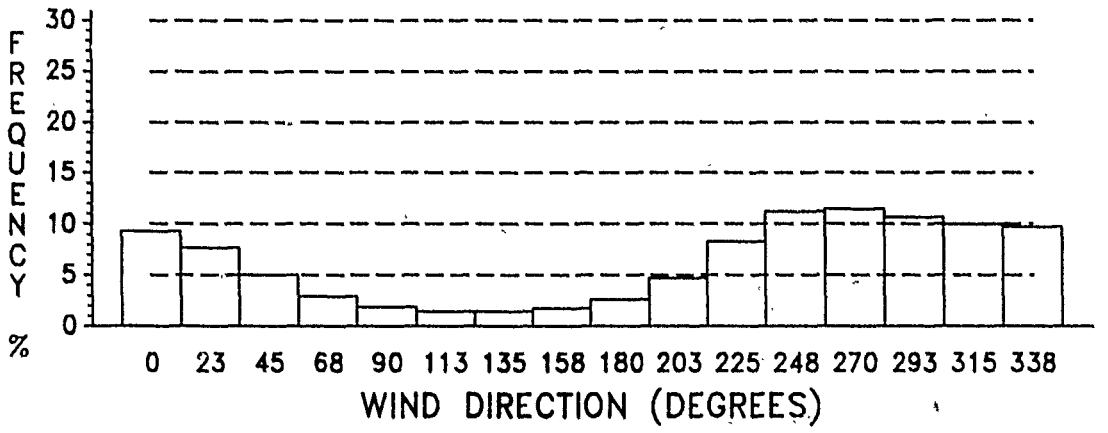


**Figure E-2. Wind Direction Frequency, January, 4 KM.**

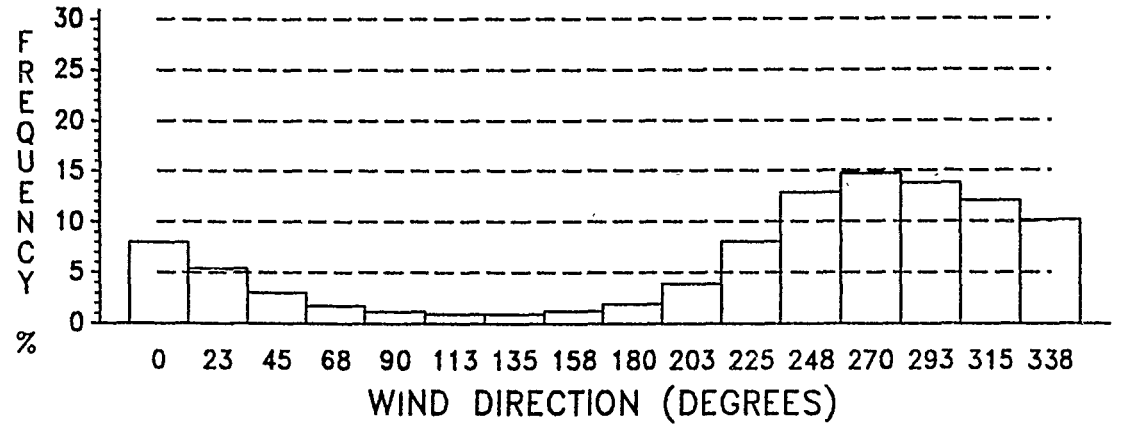


**Figure E-3. Wind Direction Frequency, January, 8 KM.**

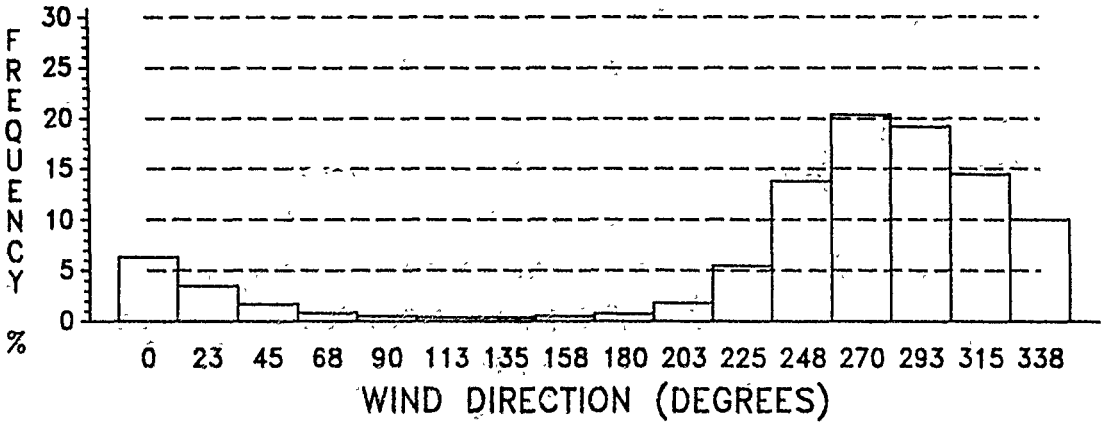


**Figure E-4. Wind Direction Frequency, January, 12 KM.**

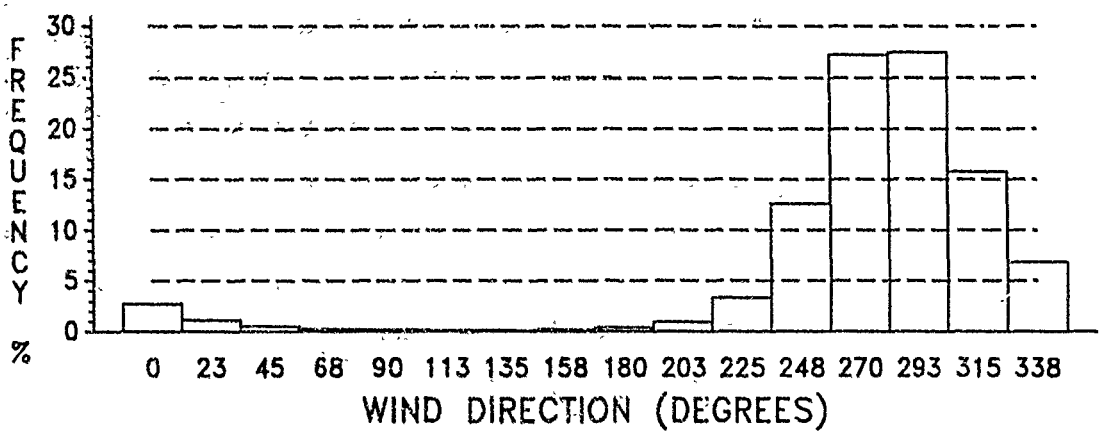


**Figure E-5. Wind Direction Frequency, January, 16 KM.**

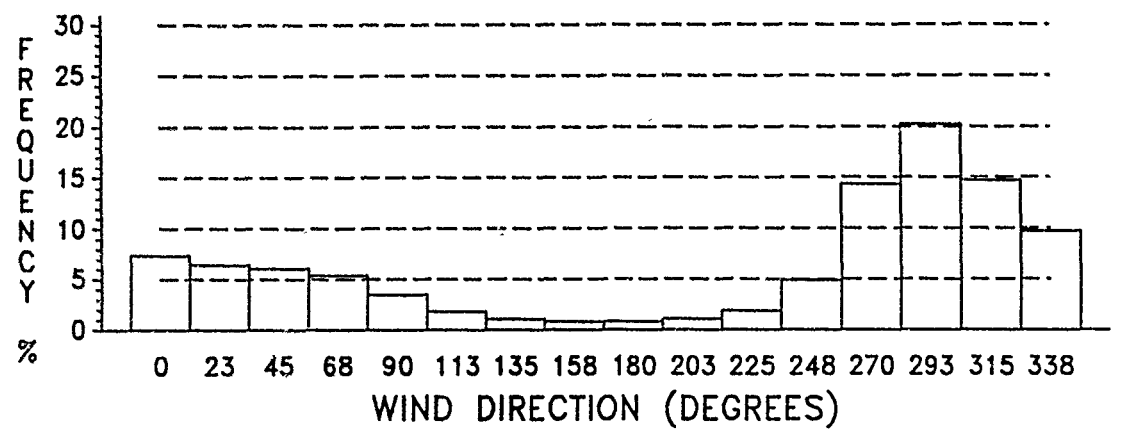


**Figure E-6. Wind Direction Frequency, January, 20 KM.**

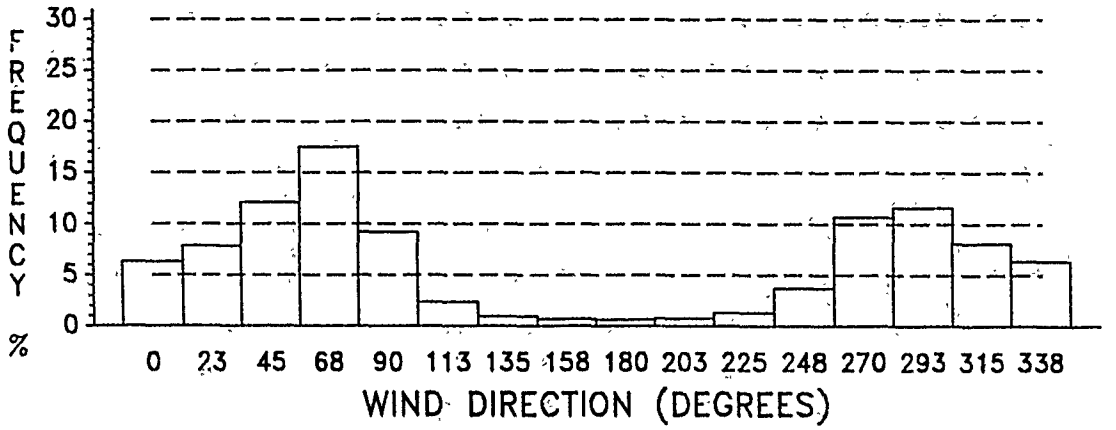


**Figure E-7. Wind Direction Frequency, January, 24 KM.**

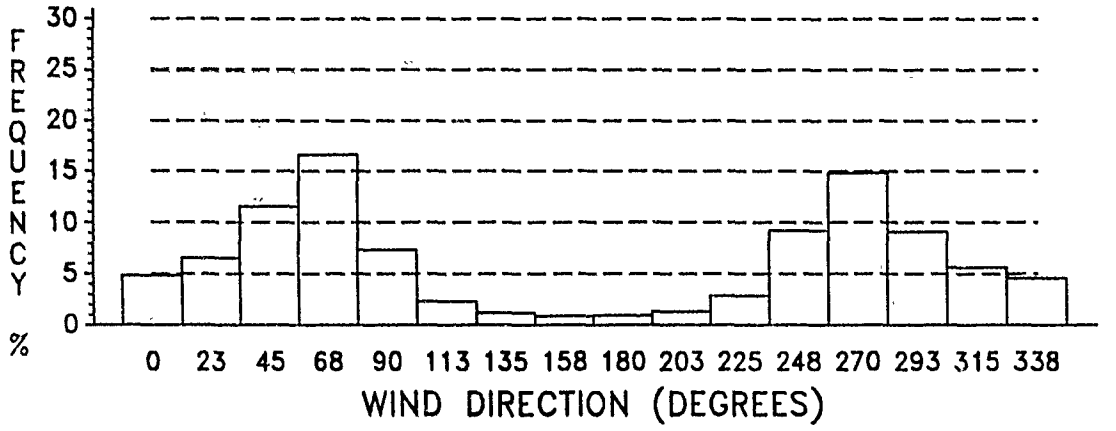


**Figure E-8. Wind Direction Frequency, January, 28 KM.**

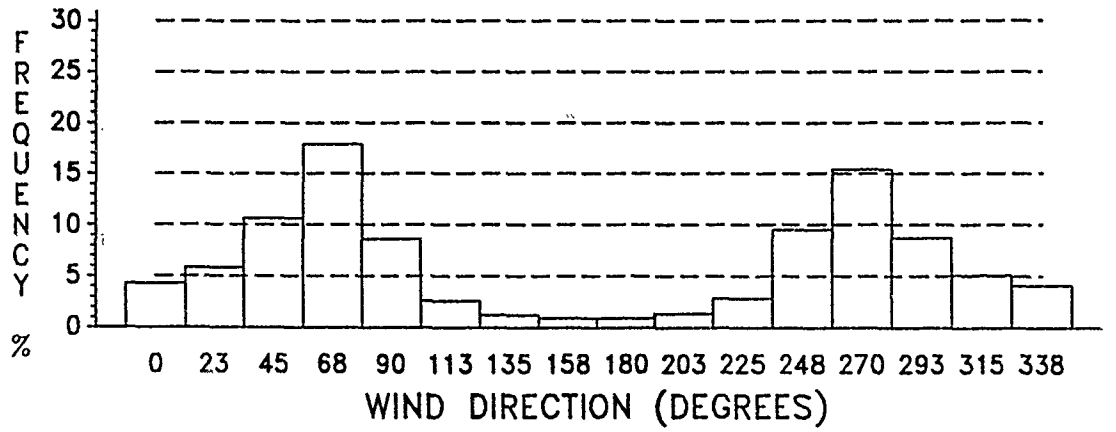


**Figure E-9. Wind Direction Frequency, January, 30 KM.**

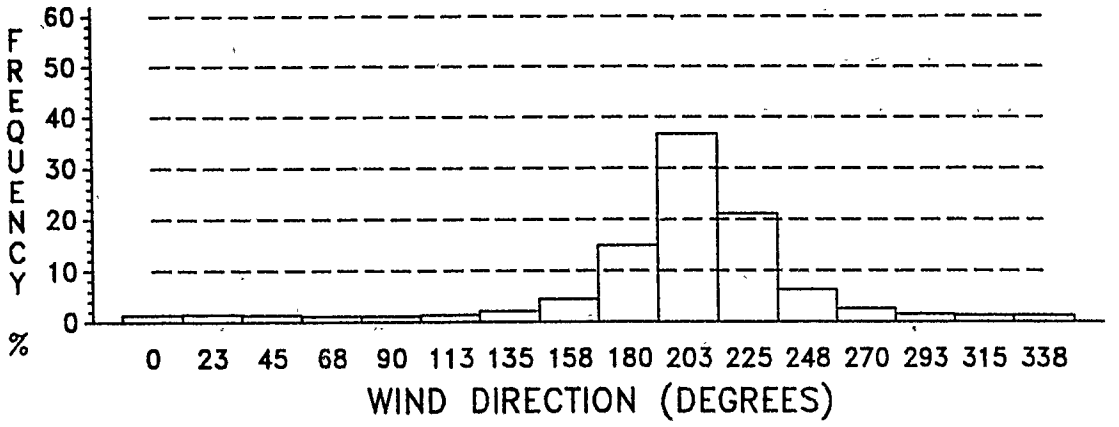


**Figure E-10. Wind Direction Frequency, July, 2 KM.**

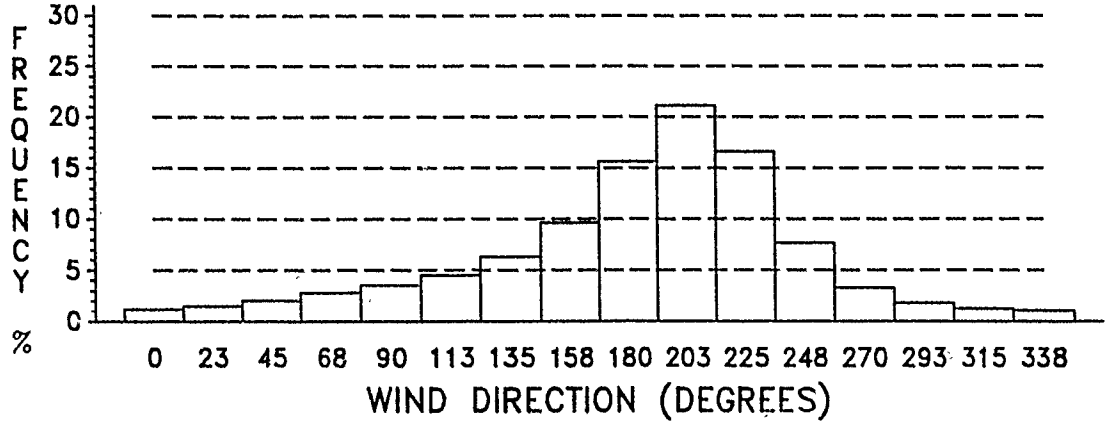


**Figure E-11. Wind Direction Frequency, July, 4 KM.**

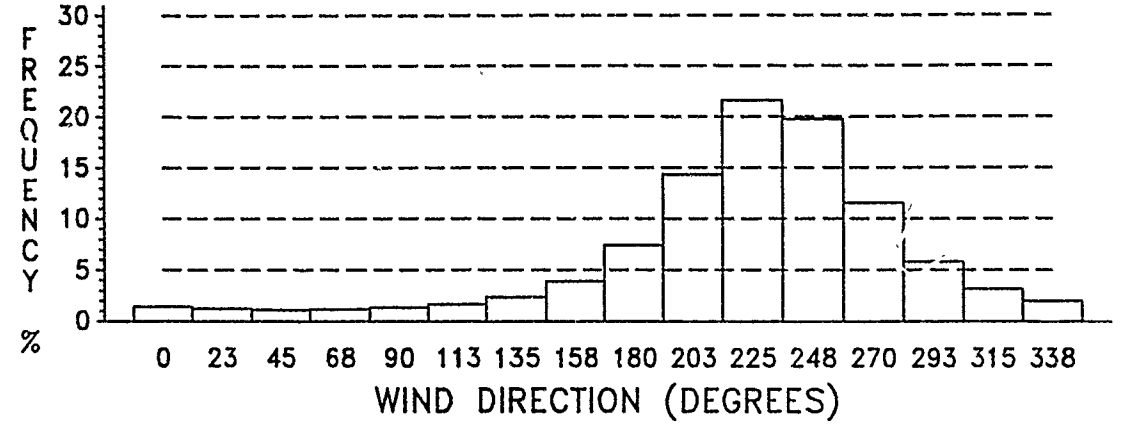


**Figure E-12. Wind Direction Frequency, July, 8 KM.**

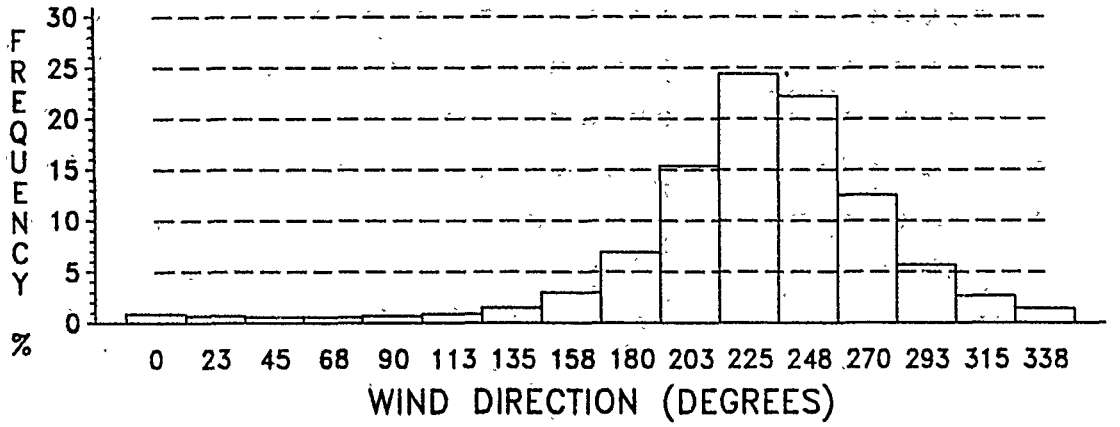


**Figure E-13. Wind Direction Frequency, July, 12 KM.**

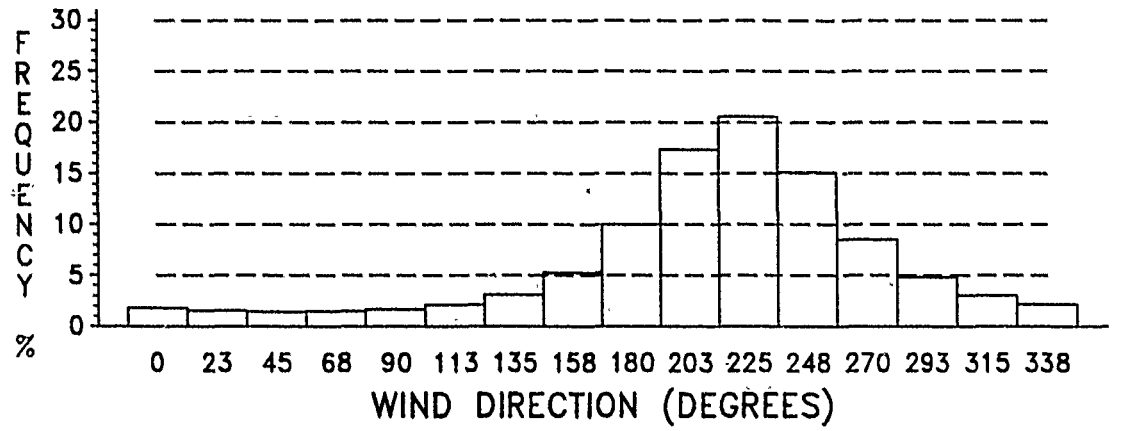


**Figure E-14. Wind Direction Frequency, July, 16 KM.**

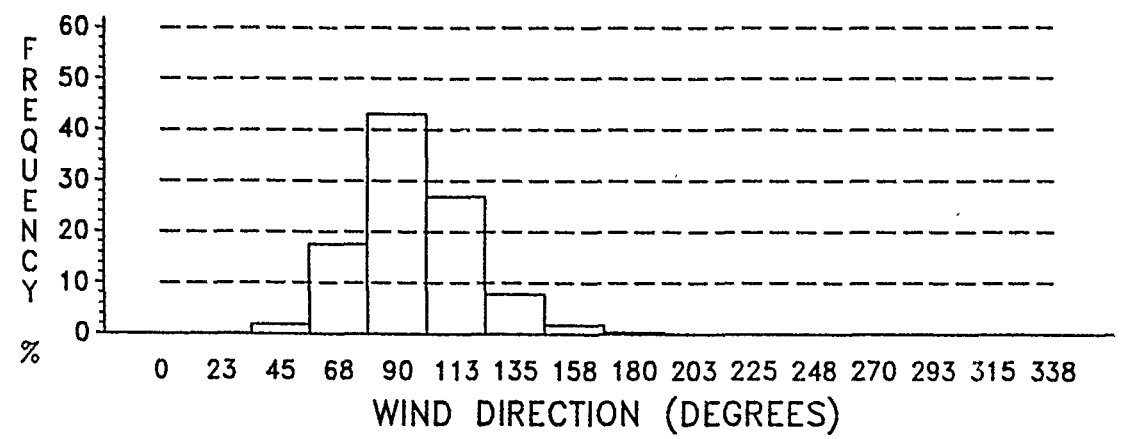


**Figure E-15. Wind Direction Frequency, July, 20 KM.**

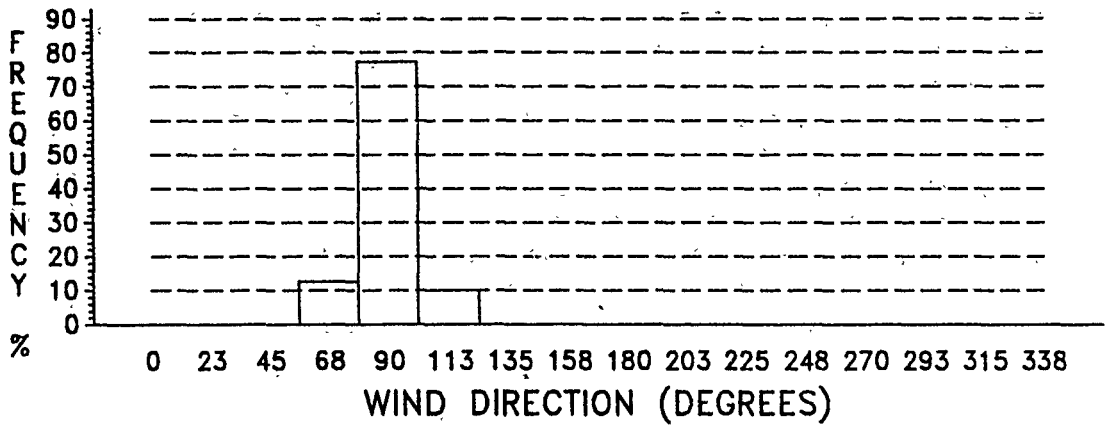


**Figure E-16. Wind Direction Frequency, July, 24 KM.**

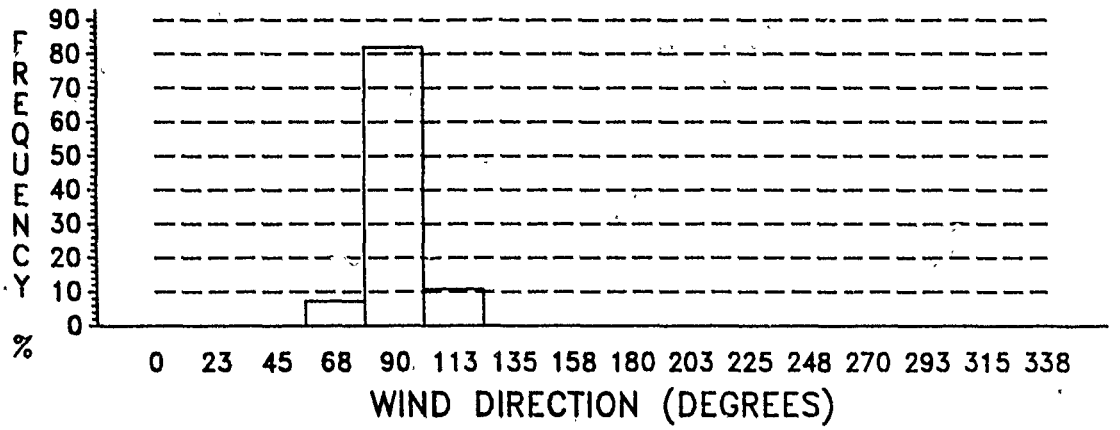


**Figure E-17. Wind Direction Frequency, July, 28 KM.**

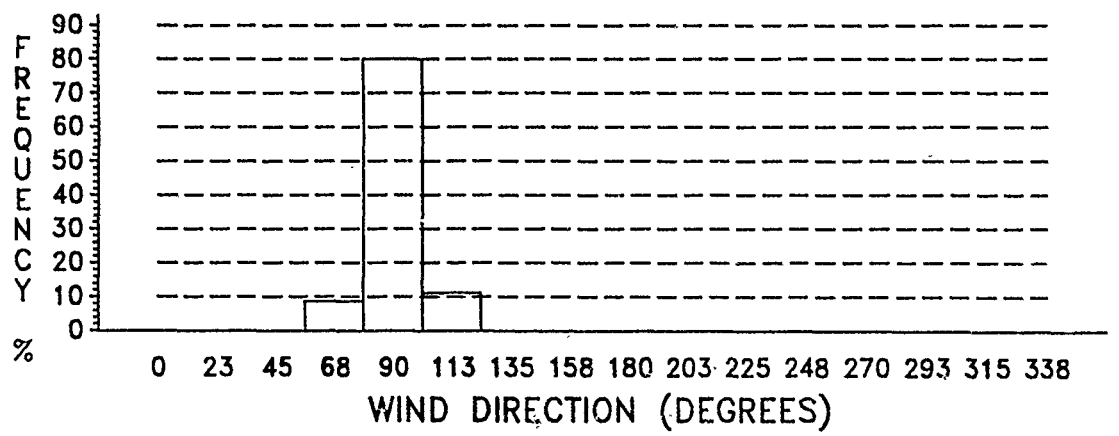


**Figure E-18. Wind Direction Frequency, July, 30 KM.**

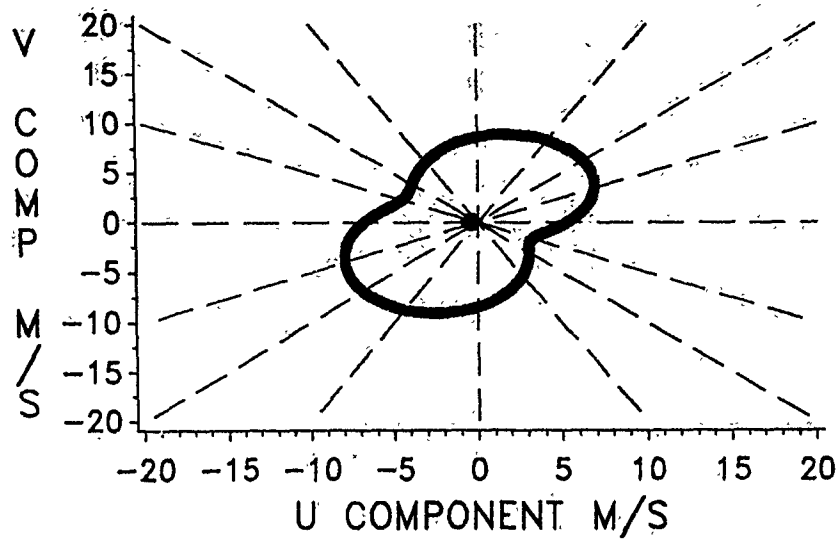


**Figure E-19. Wind Interpercentile Range and Mean, January, 2 KM.**

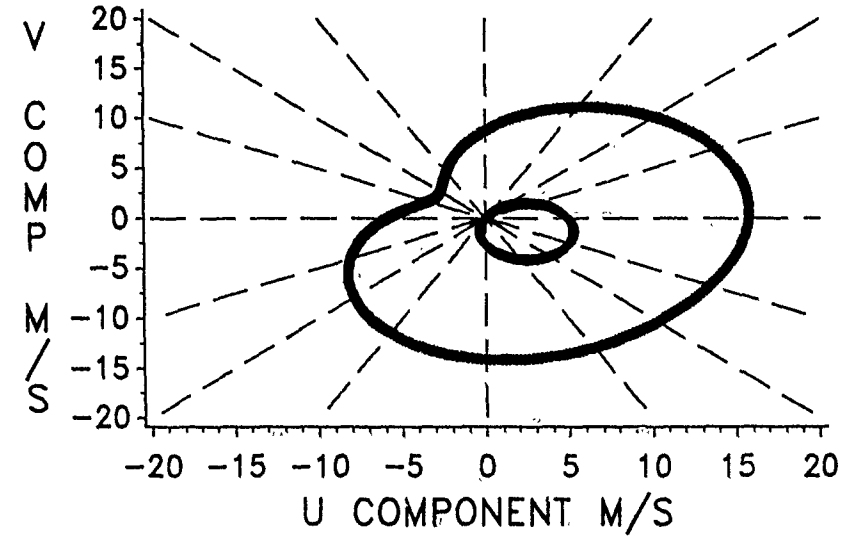


**Figure E-20. Wind Interpercentile Range and Mean, January, 4 KM.**

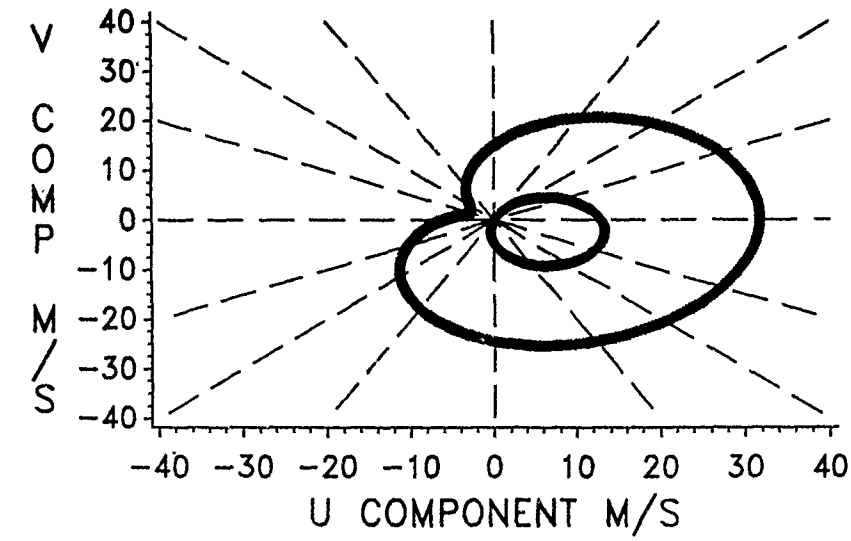


**Figure E-21. Wind Interpercentile Range and Mean, January, 8 KM.**

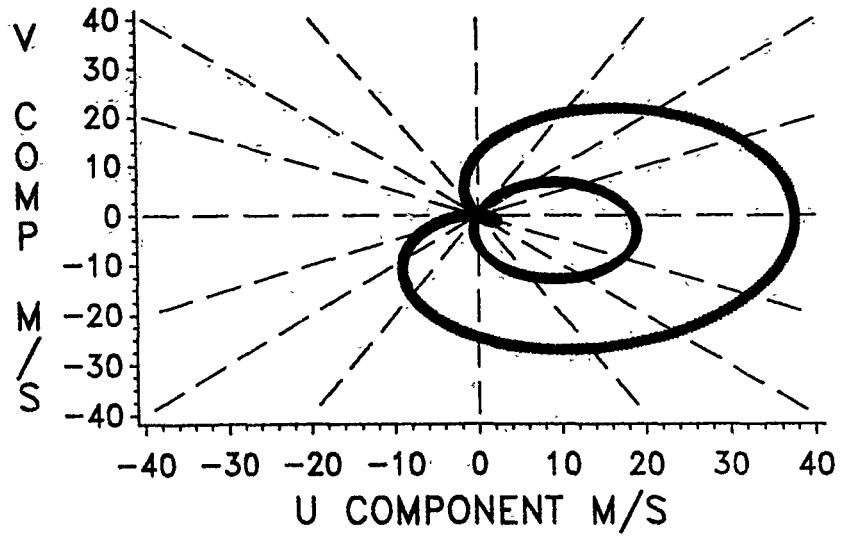


**Figure E-22. Wind Interpercentile Range and Mean, January, 12 KM.**

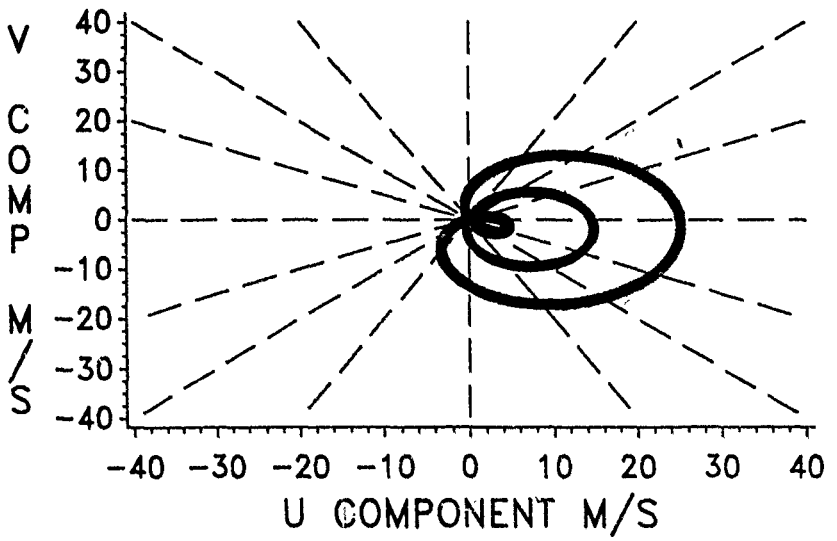


**Figure E-23. Wind Interpercentile Range and Mean, January, 16 KM.**

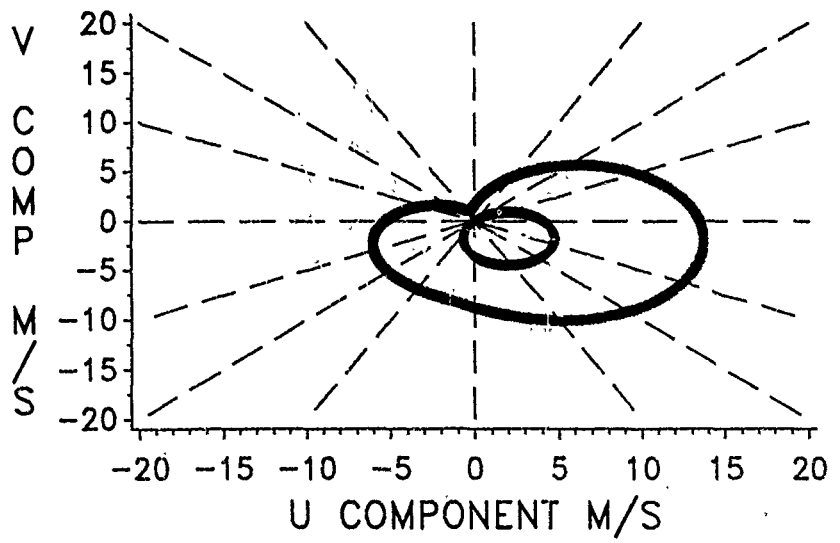


**Figure E-24. Wind Interpercentile Range and Mean, January, 20 KM.**

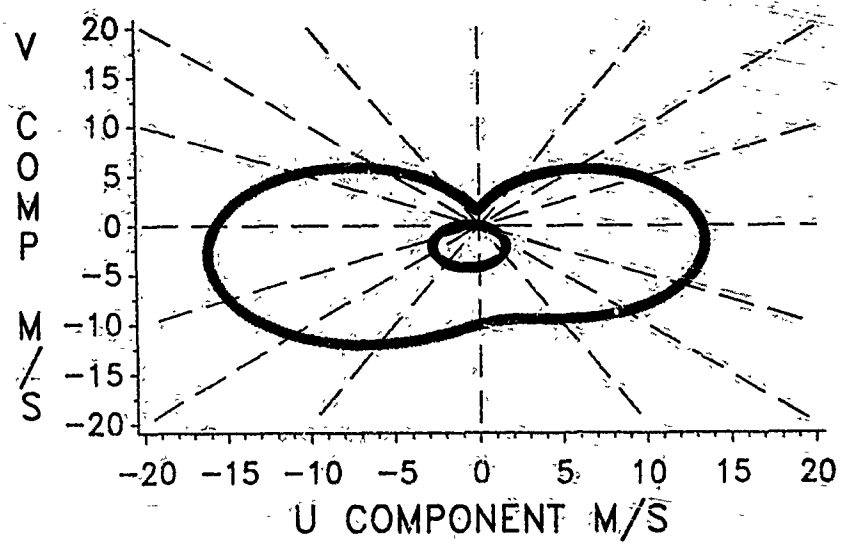


**Figure E-25. Wind Interpercentile Range and Mean, January, 24 KM.**

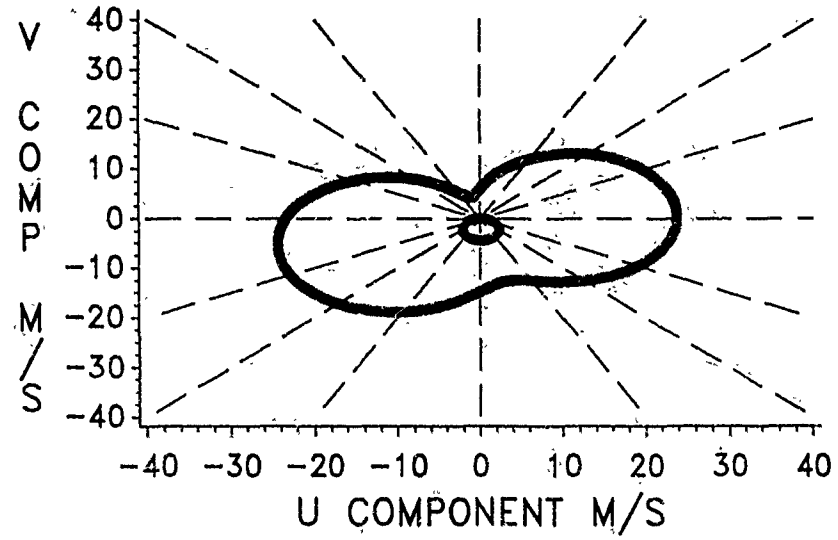


**Figure E-26. Wind Interpercentile Range and Mean, January, 28 KM.**

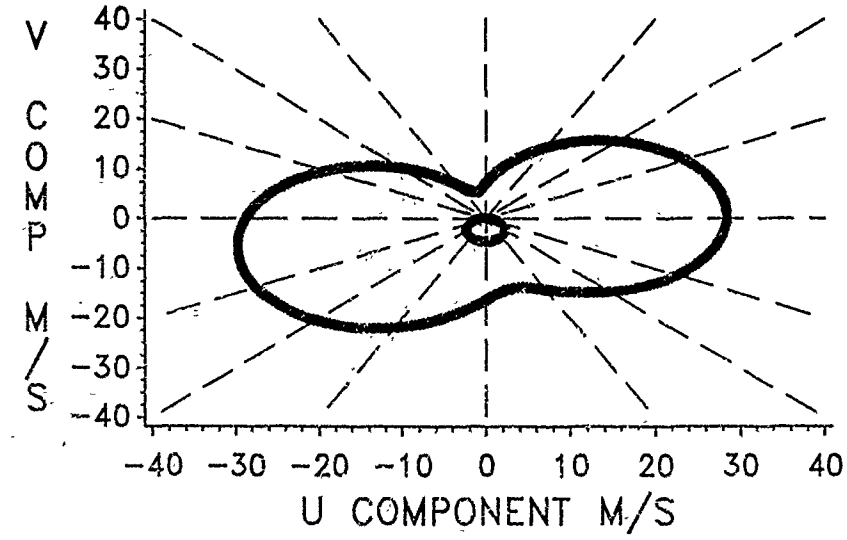


**Figure E-27. Wind Interpercentile Range and Mean, January, 30 KM.**

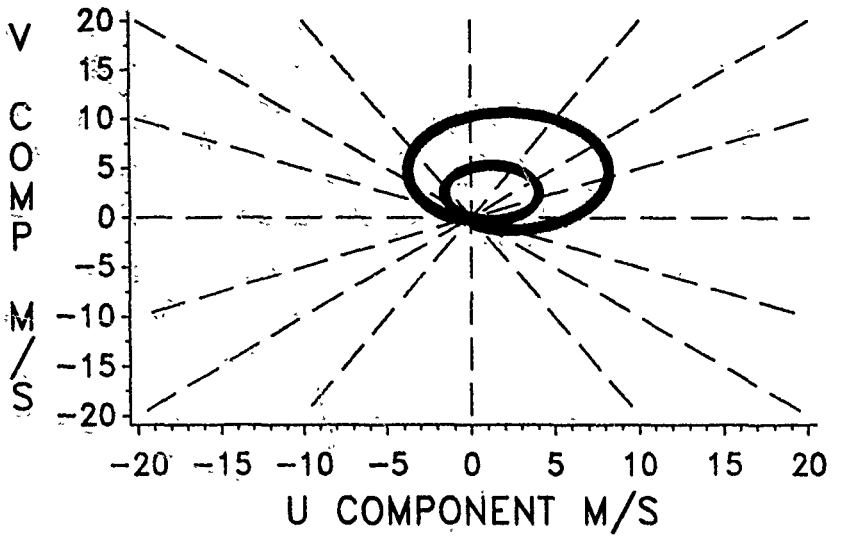


**Figure E-28. Wind Interpercentile Range and Mean, July, 2 KM.**

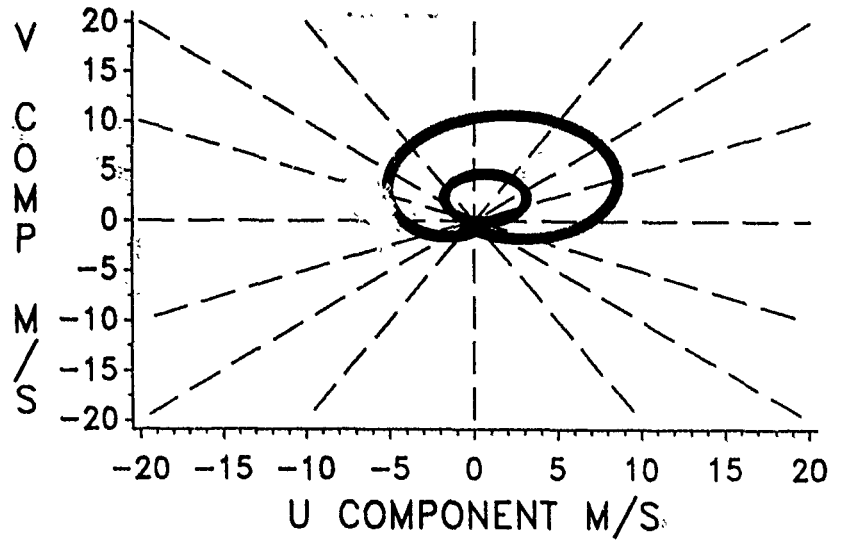


**Figure E-29. Wind Interpercentile Range and Mean, July, 4 KM.**

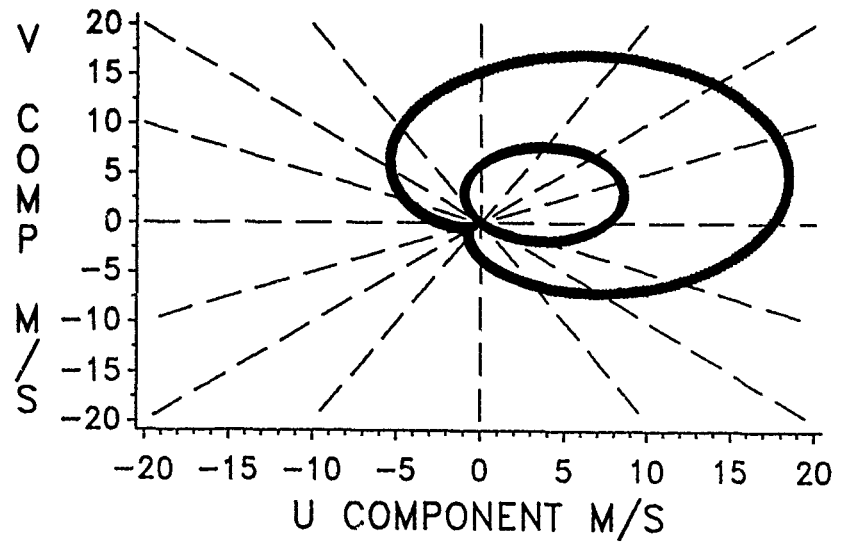


**Figure E-30. Wind Interpercentile Range and Mean, July, 8 KM.**

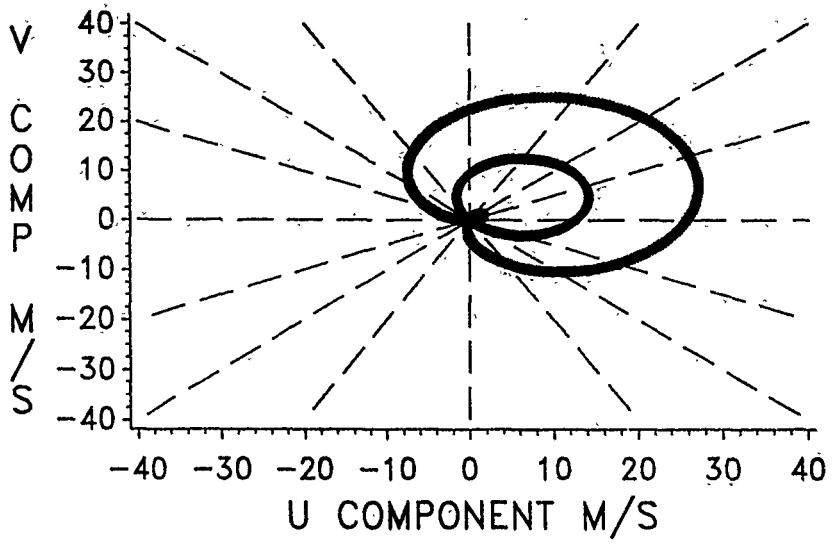


**Figure E-31. Wind Interpercentile Range and Mean, July, 12 KM.**

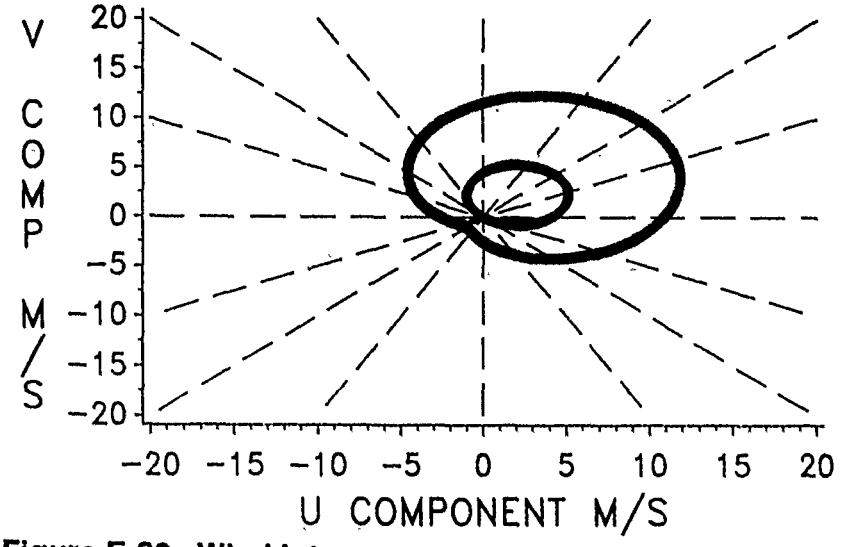


**Figure E-32. Wind Interpercentile Range and Mean, July, 16 KM.**

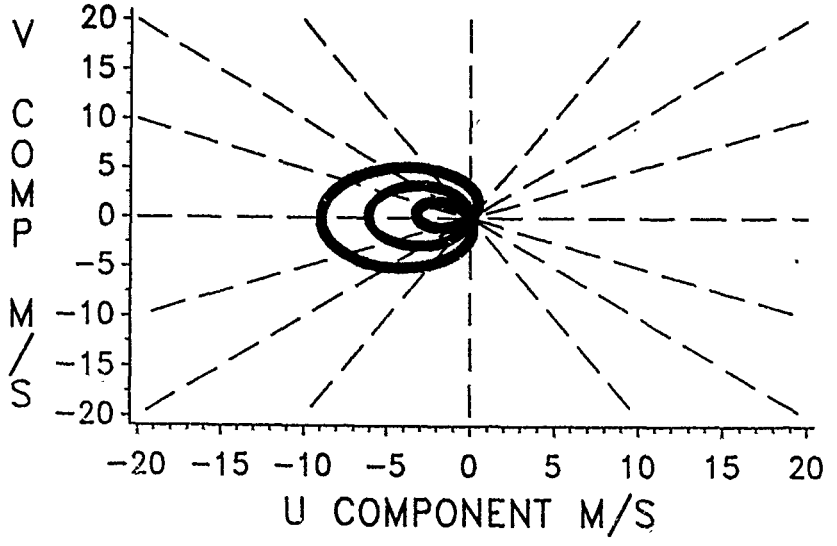


**Figure E-33. Wind Interpercentile Range and Mean, July, 20 KM.**

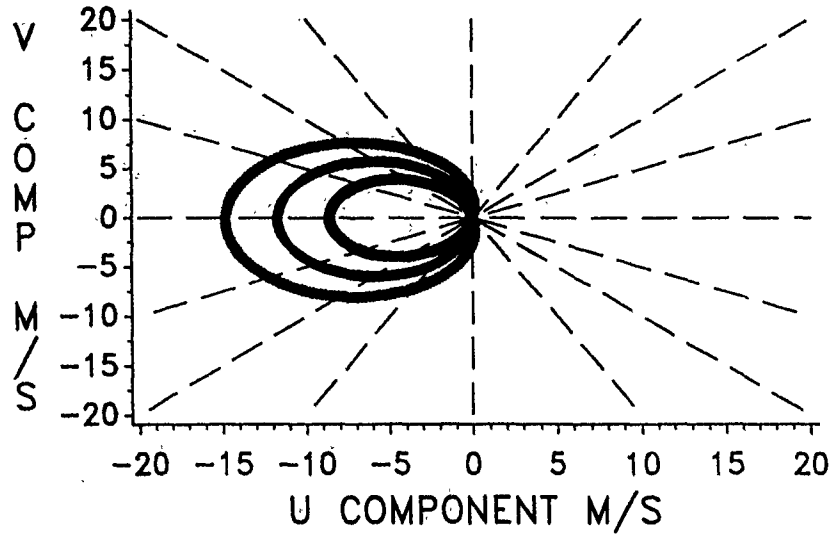


**Figure E-34. Wind Interpercentile Range and Mean, July, 24 KM.**

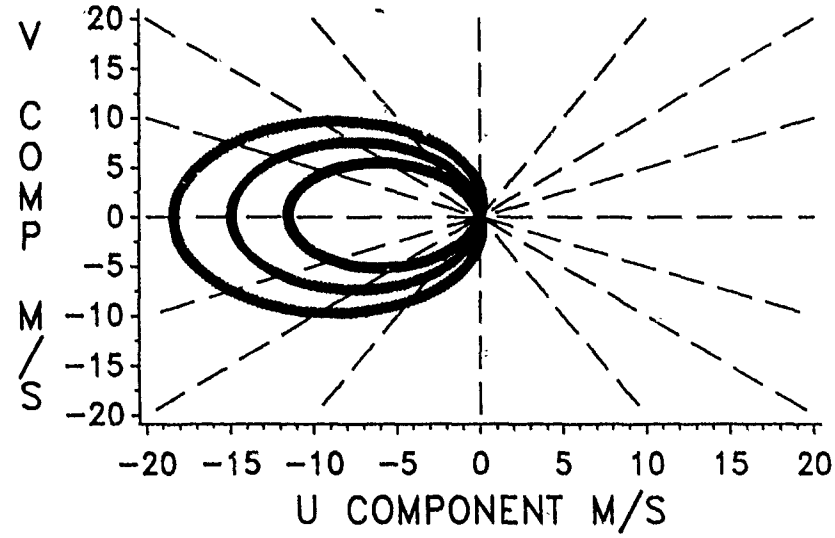


**Figure E-35. Wind Interpercentile Range and Mean, July, 28 KM.**

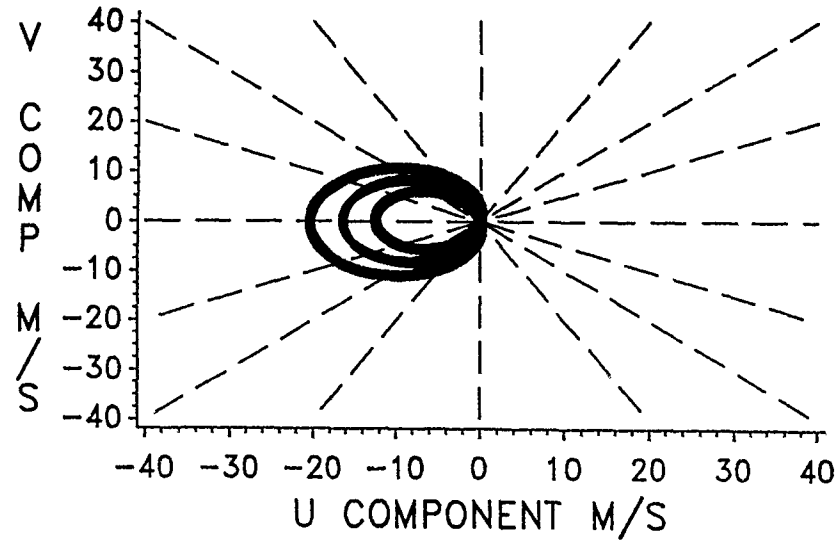


**Figure E-36. Wind Interpercentile Range and Mean, July, 30 KM.**

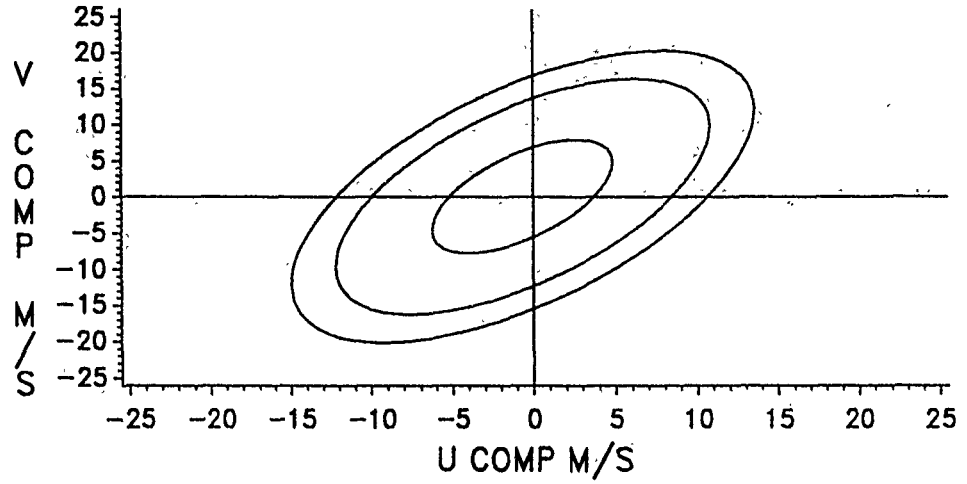


**Figure E-37. Wind Probability Ellipses, January, 2 KM.**

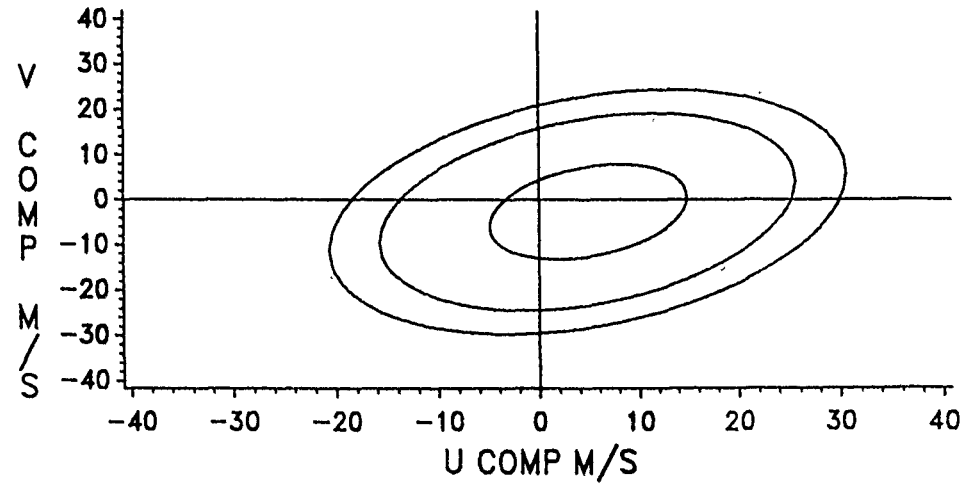


**Figure E-38. Wind Probability Ellipses, January, 4 KM.**

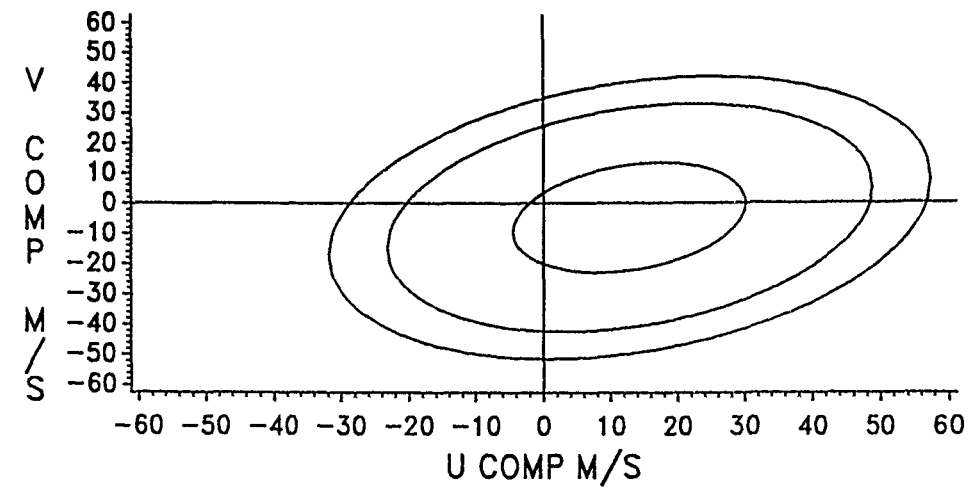


**Figure E-39. Wind Probability Ellipses, January, 8 KM.**

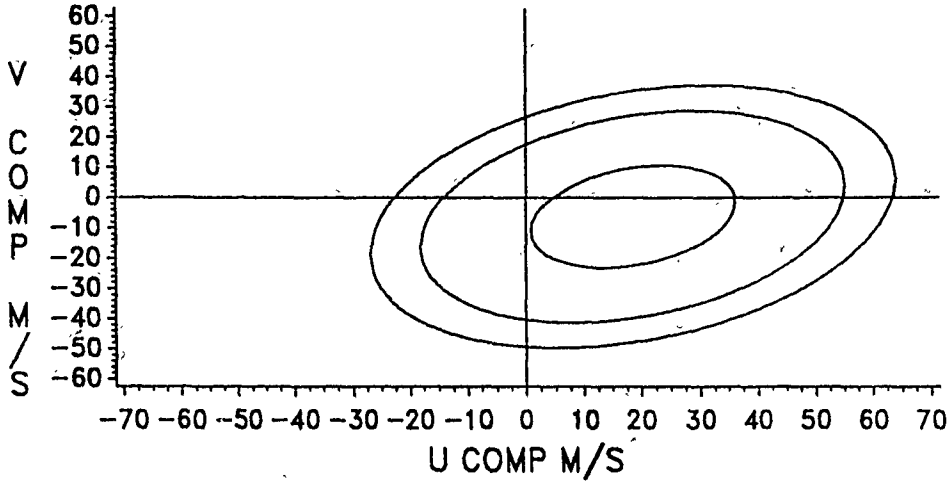


**Figure E-40. Wind Probability Ellipses, January, 12 KM.**

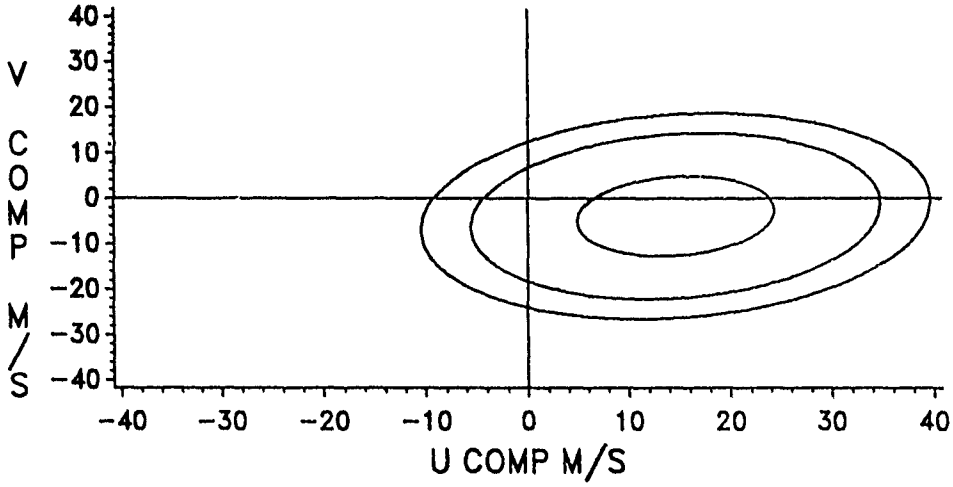


**Figure E-41. Wind Probability Ellipses, January, 16 KM.**

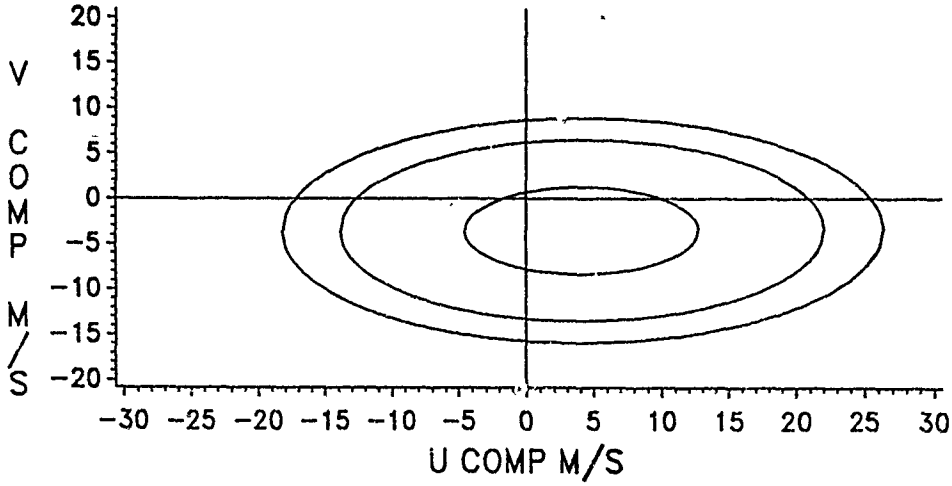


**Figure E-42. Wind Probability Ellipses, January, 20 KM.**

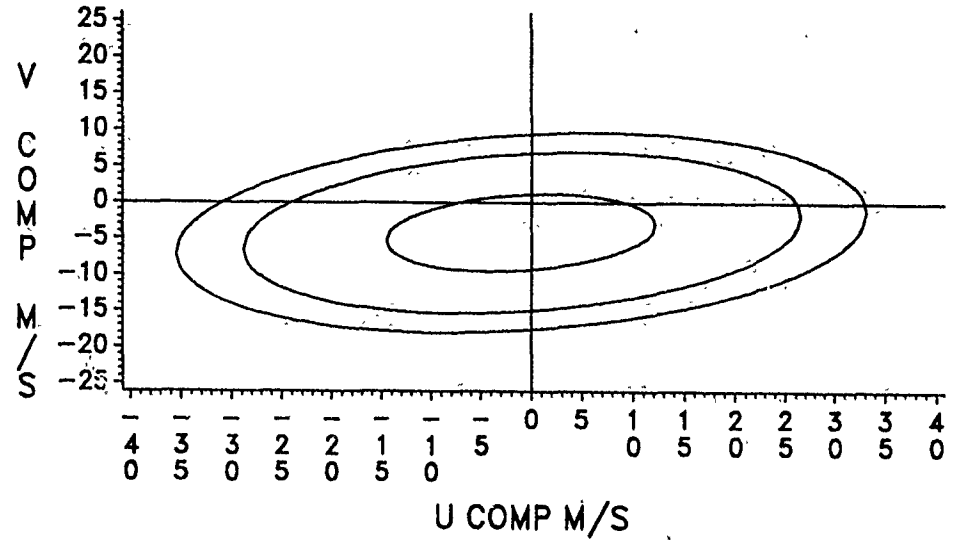


**Figure E-43. Wind Probability Ellipses, January, 24 KM.**

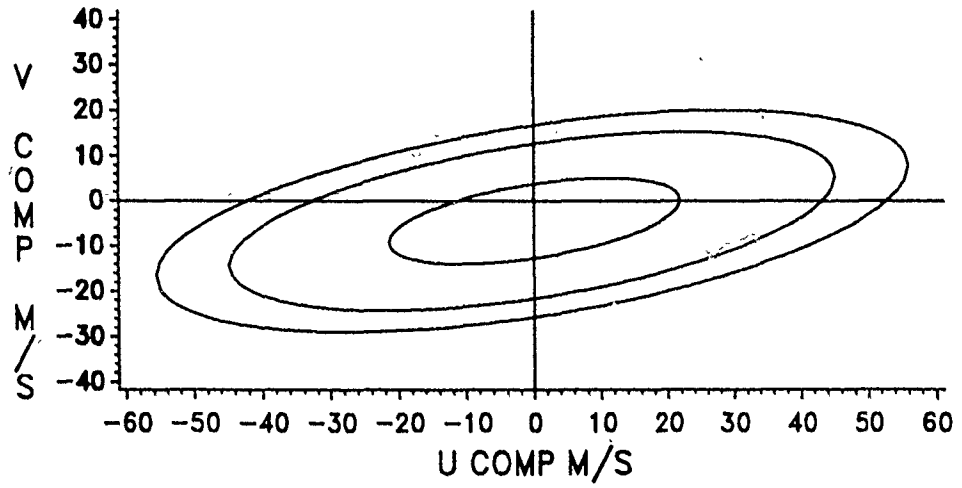


**Figure E-44. Wind Probability Ellipses, January, 28 KM.**

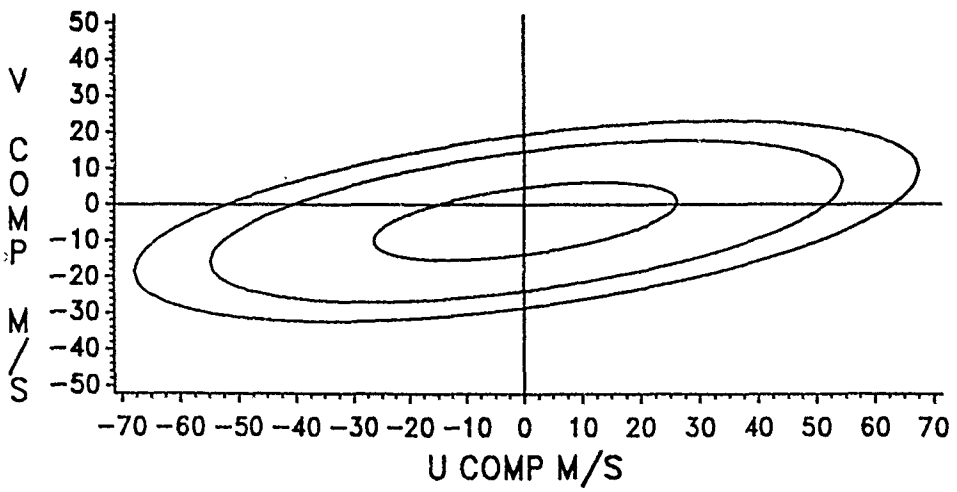


**Figure E-45. Wind Probability Ellipses, January, 30 KM.**

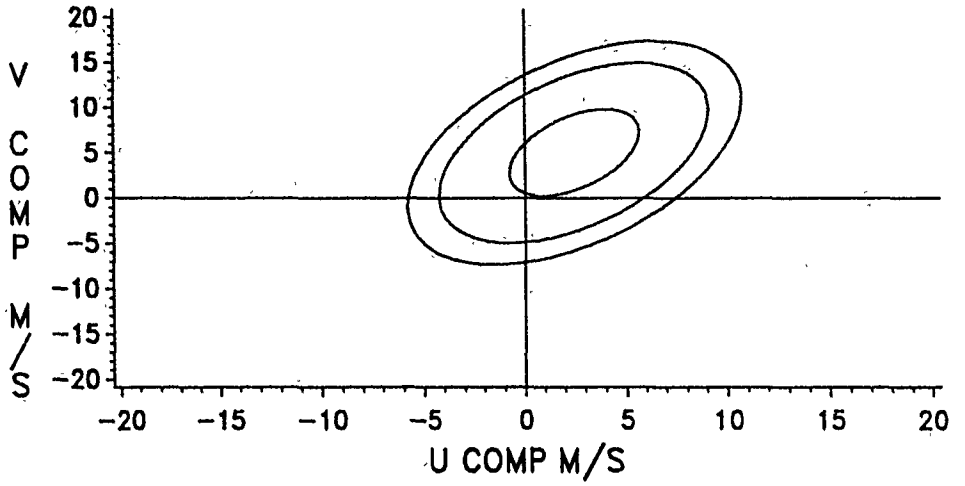


**Figure E-46. Wind Probability Ellipses, July, 2 KM.**

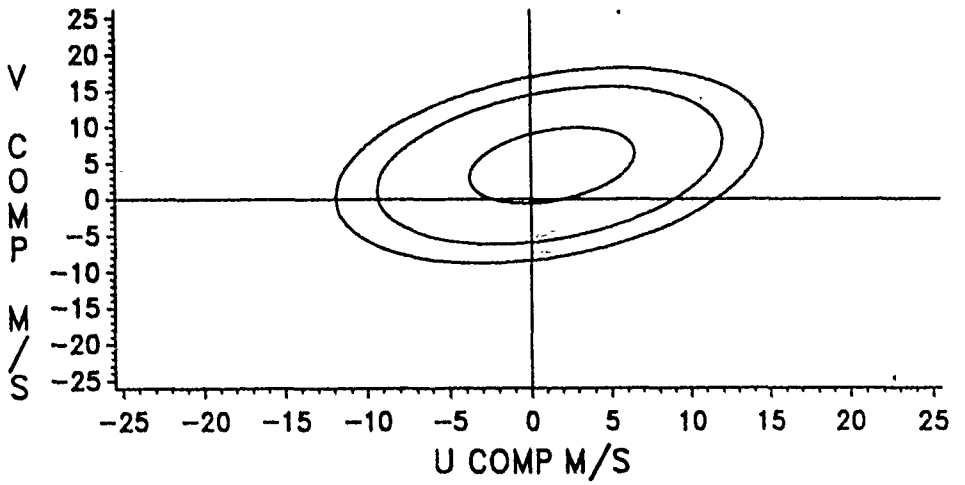


**Figure E-47. Wind Probability Ellipses, July, 4 KM.**

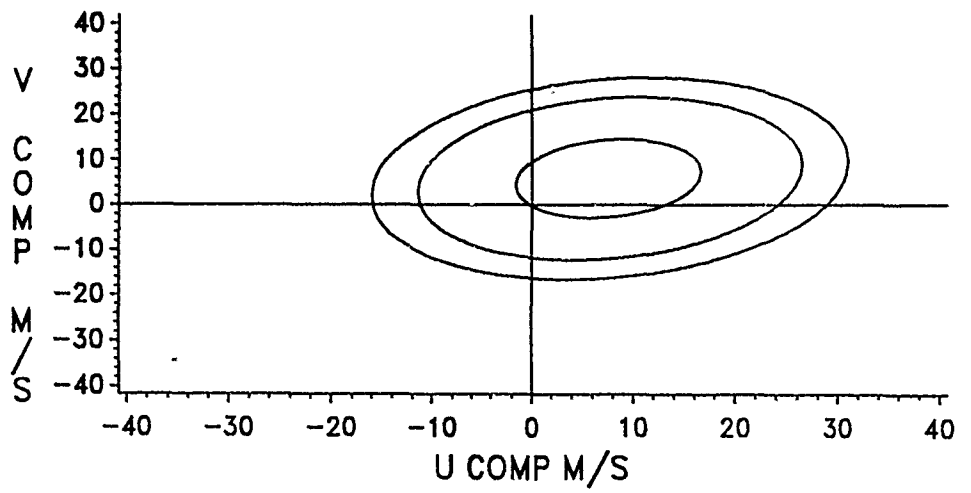


**Figure E-48. Wind Probability Ellipses, July, 8 KM.**

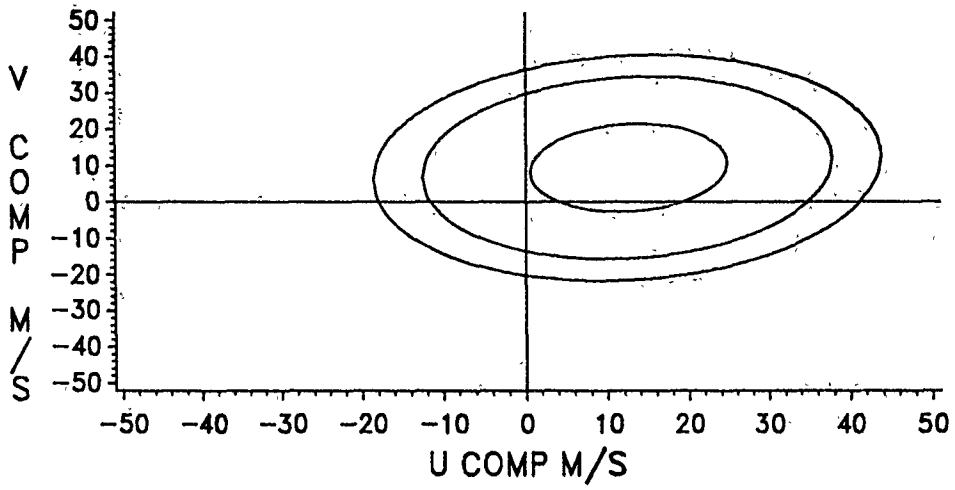


**Figure E-49. Wind Probability Ellipses, July, 12 KM.**

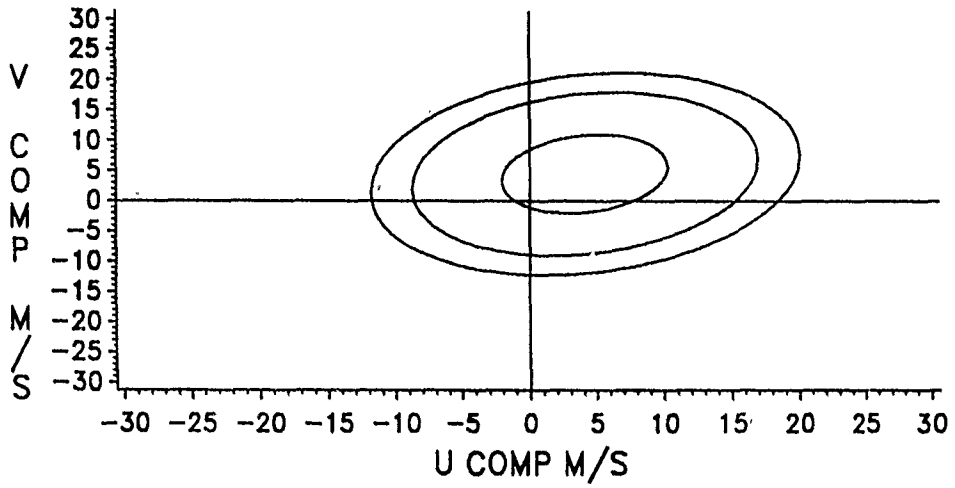


**Figure E-50. Wind Probability Ellipses, July, 16 KM.**

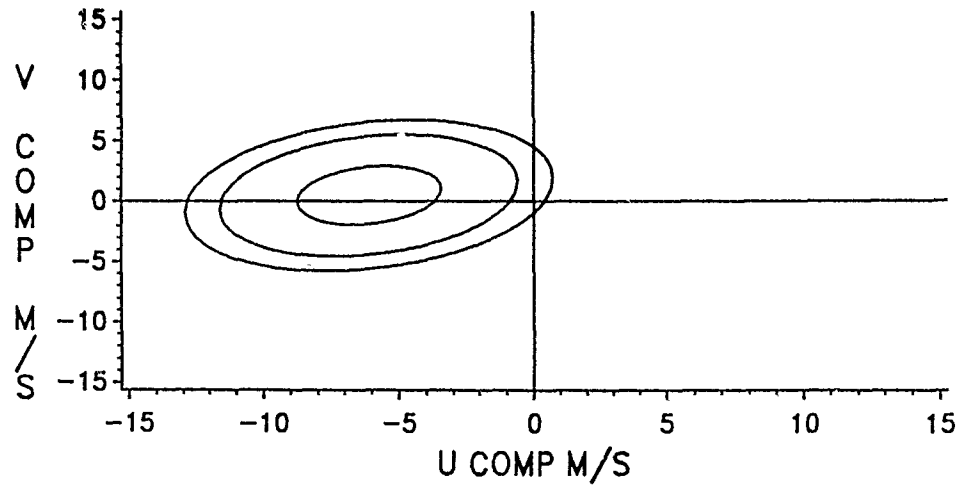


**Figure E-51. Wind Probability Ellipses, July, 20 KM.**

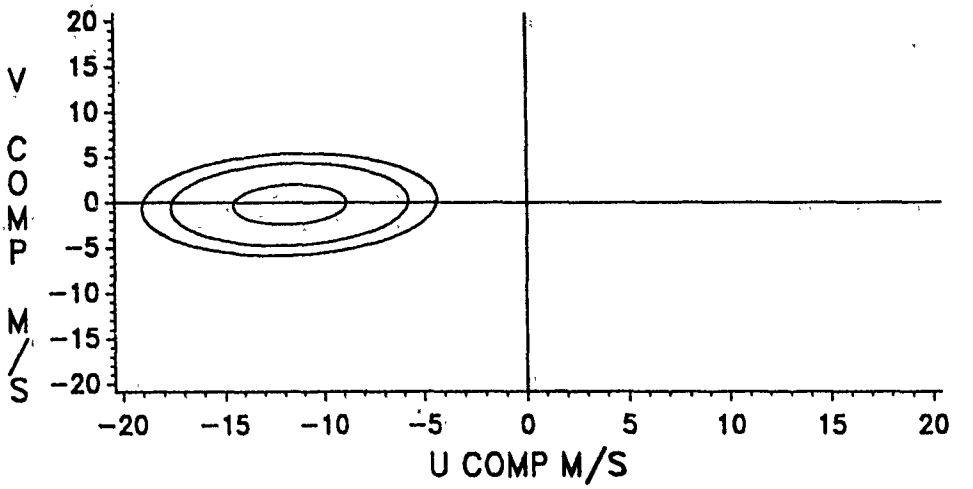


**Figure E-52. Wind Probability Ellipses, July, 24 KM.**

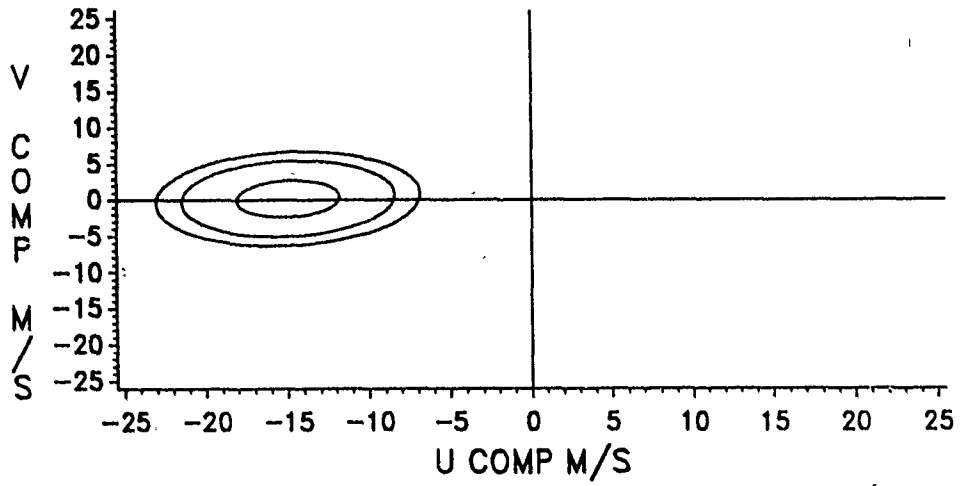


**Figure E-53. Wind Probability Ellipses, July, 28 KM.**

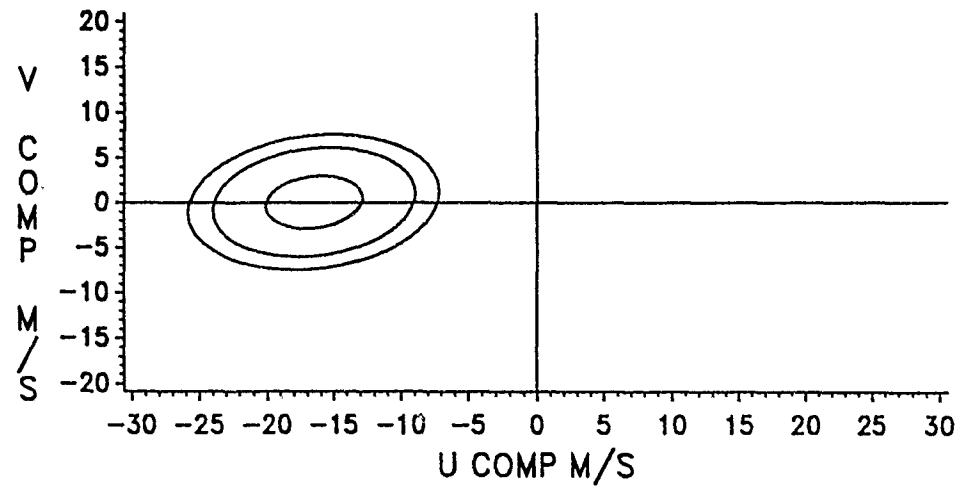


**Figure E-54. Wind Probability Ellipses, July, 30 KM.**

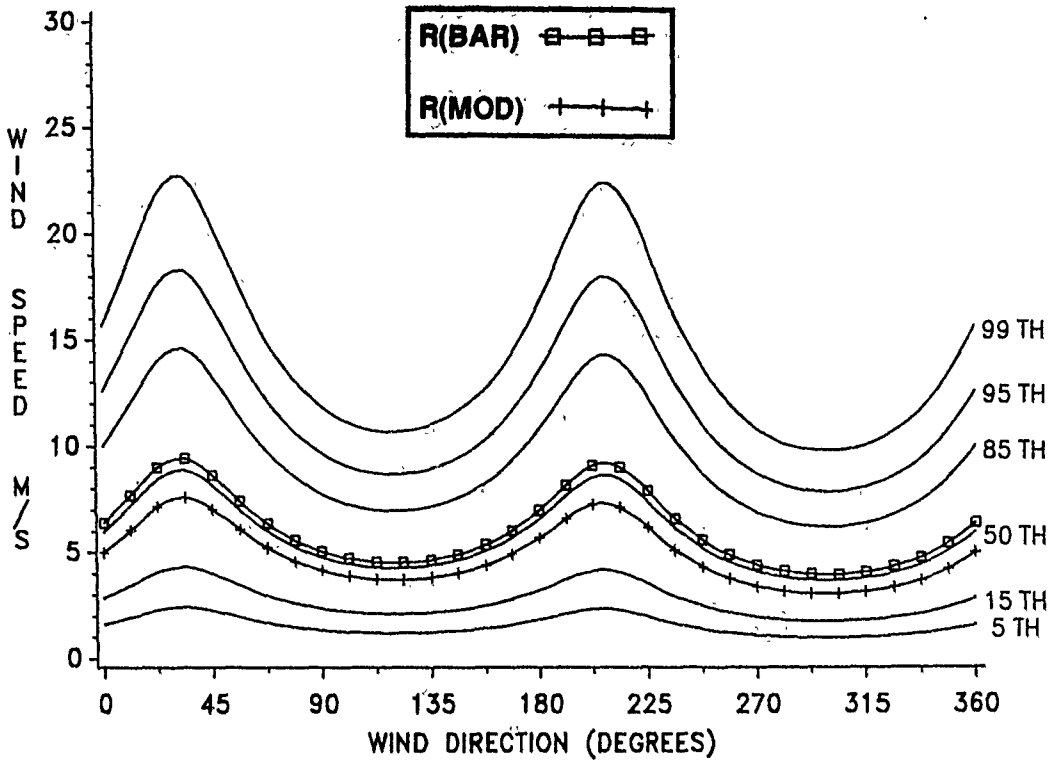


**Figure E-55. Conditional Wind Speed Given Direction, January, 2 KM.**

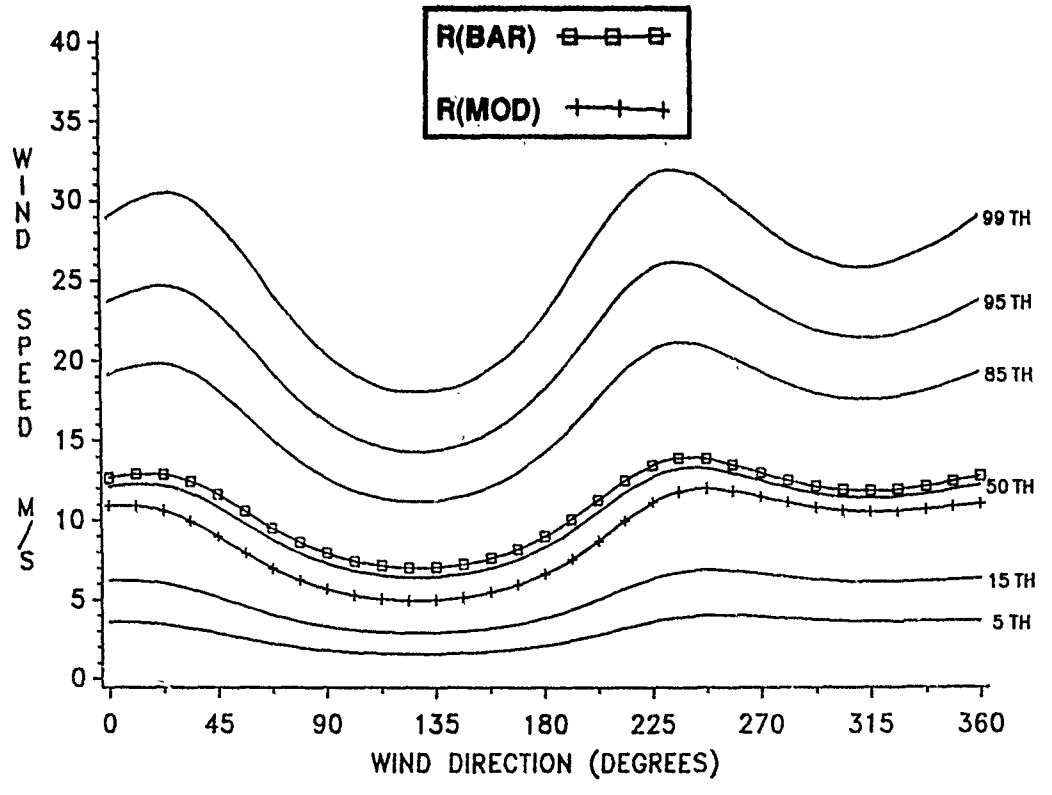


**Figure E-56. Conditional Wind Speed Given Direction, January, 4 KM.**

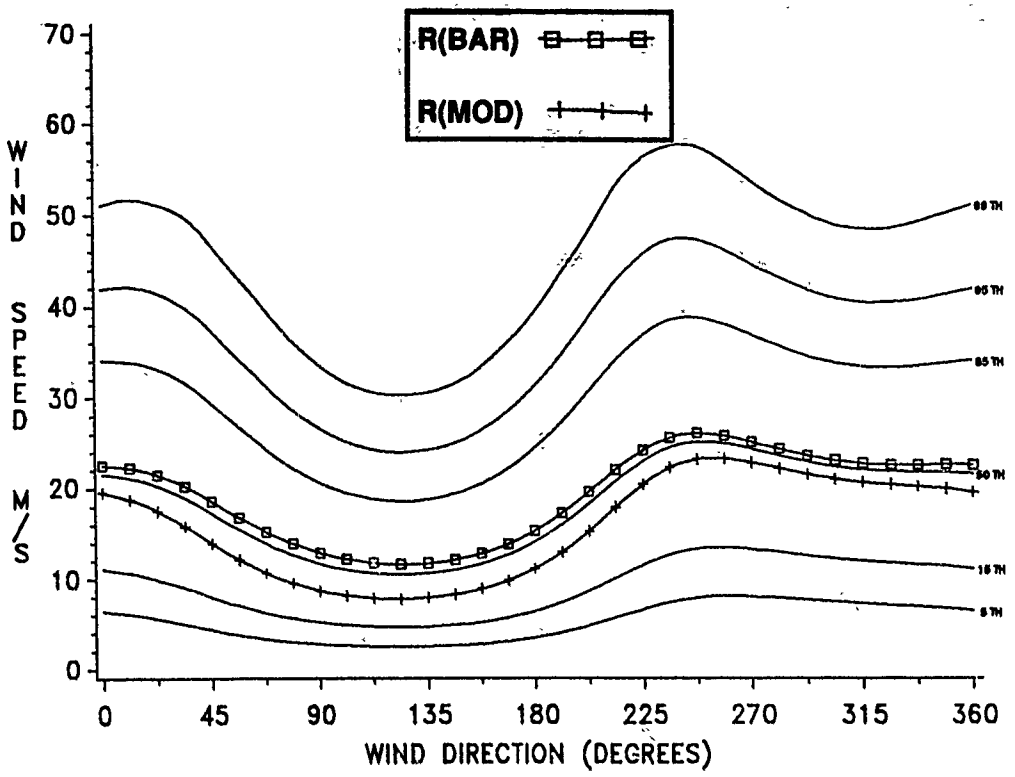


**Figure E-57. Conditional Wind Speed Given Direction, January, 8 KM.**

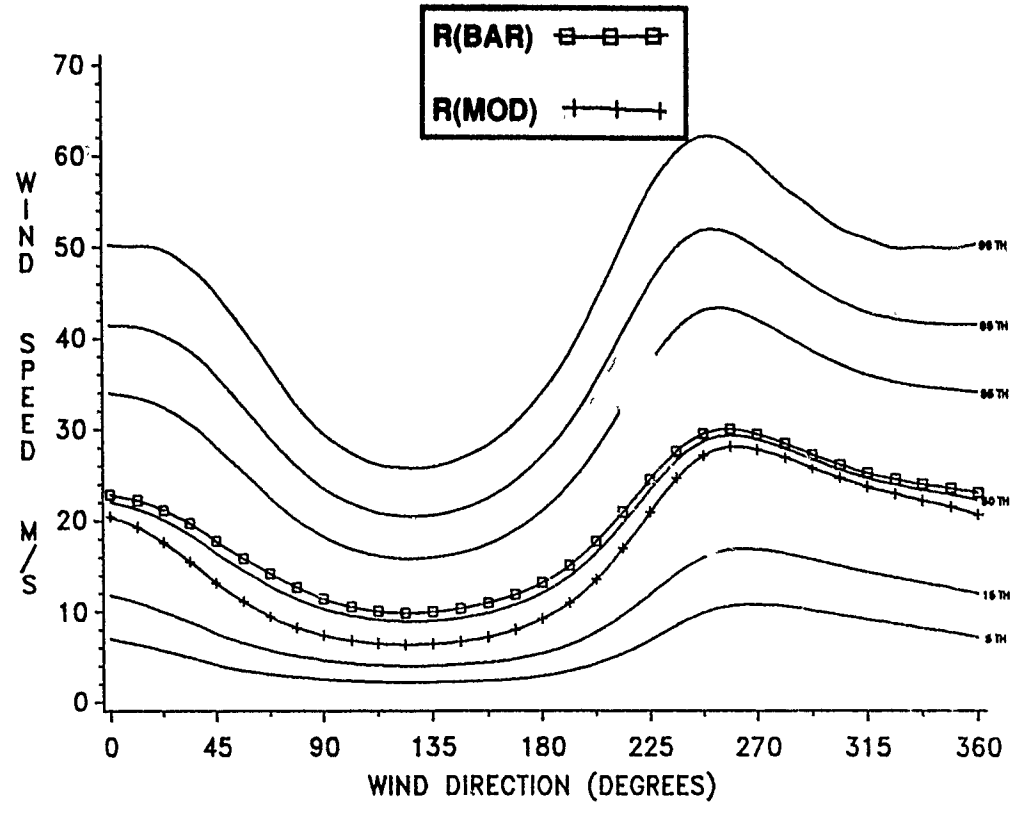


**Figure E-58. Conditional Wind Speed Given Direction, January, 12 KM.**

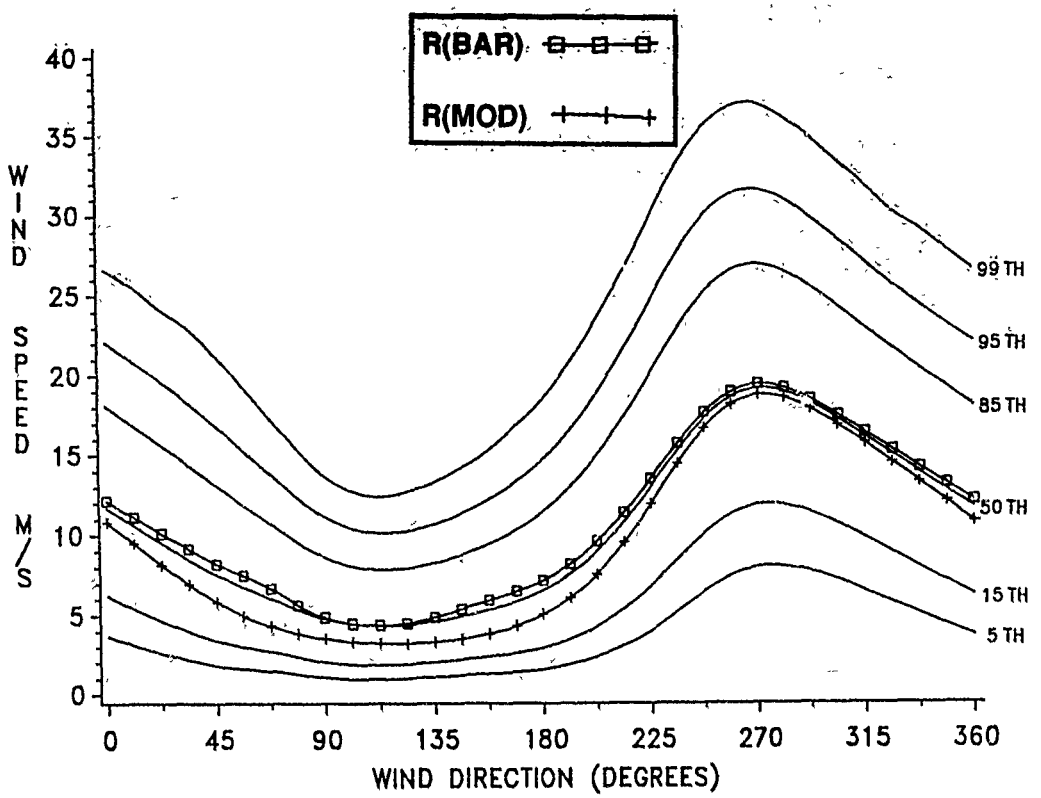


**Figure E-59. Conditional Wind Speed Given Direction, January, 16 KM.**

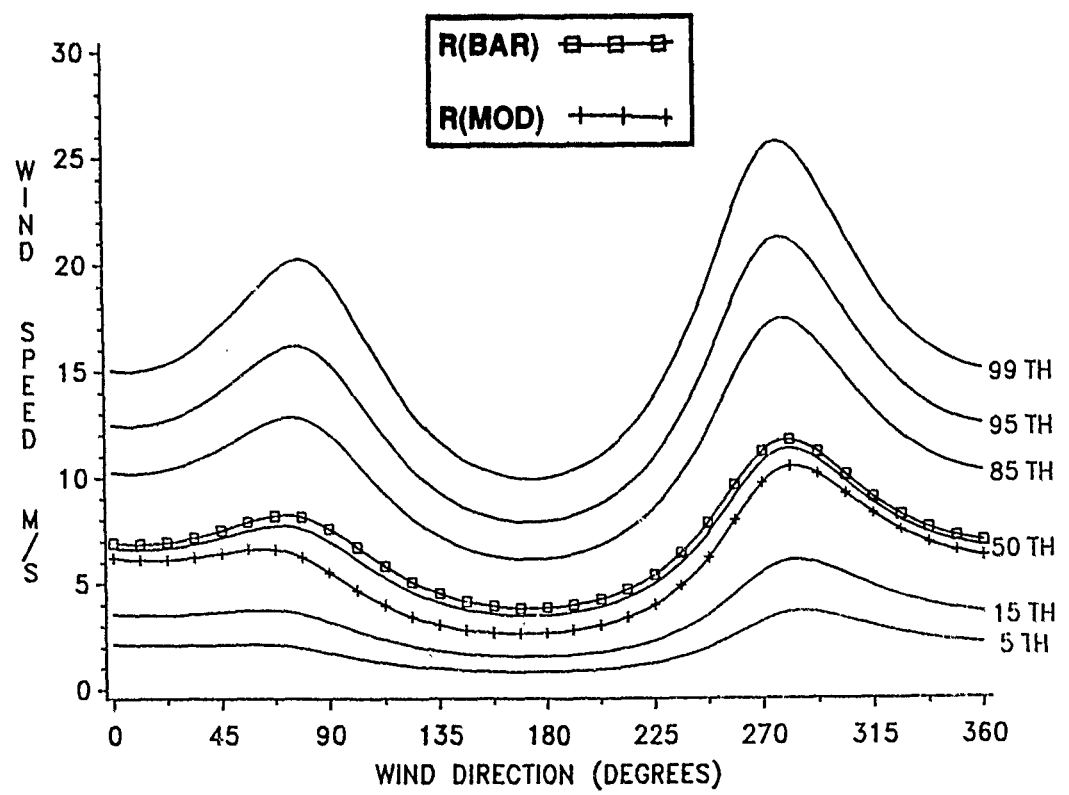


**Figure E-60. Conditional Wind Speed Given Direction, January, 20 KM.**

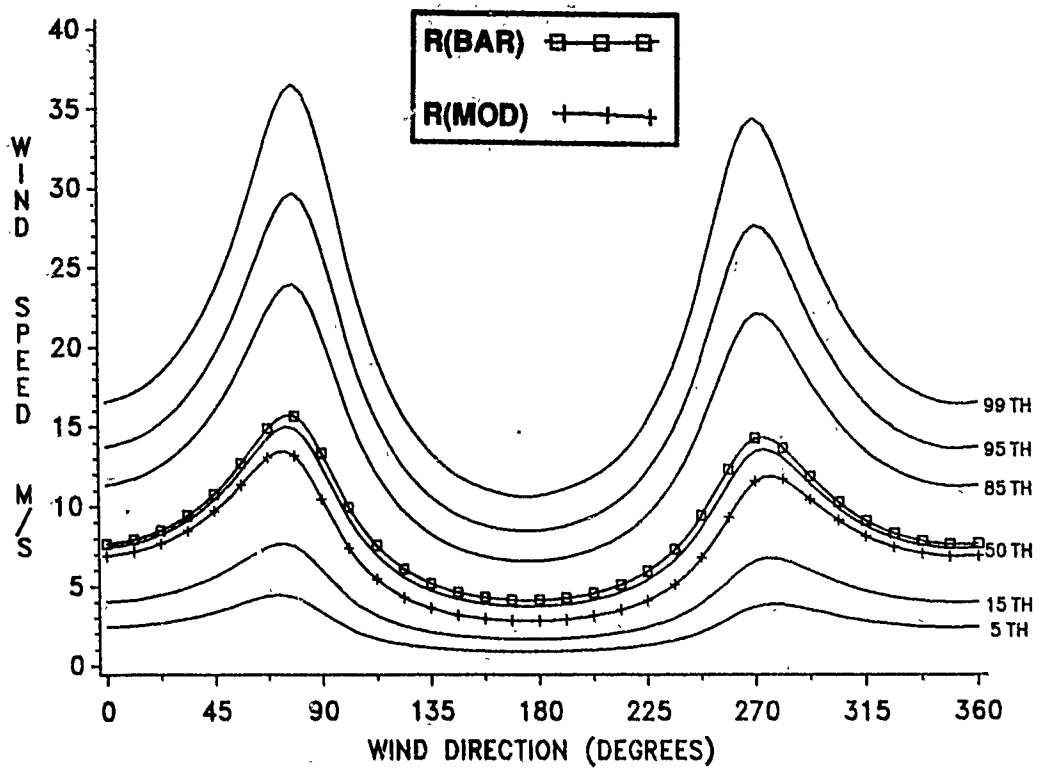


**Figure E-61. Conditional Wind Speed Given Direction, January, 24 KM.**

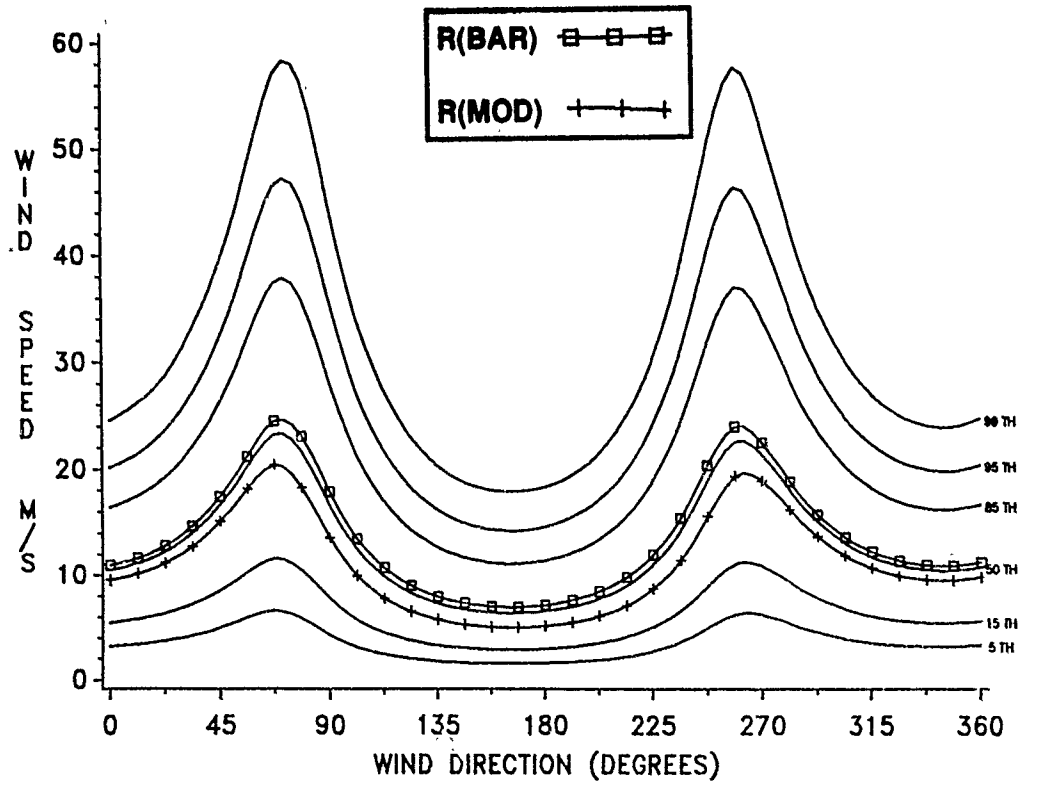


**Figure E-62. Conditional Wind Speed Given Direction, January, 28 KM.**

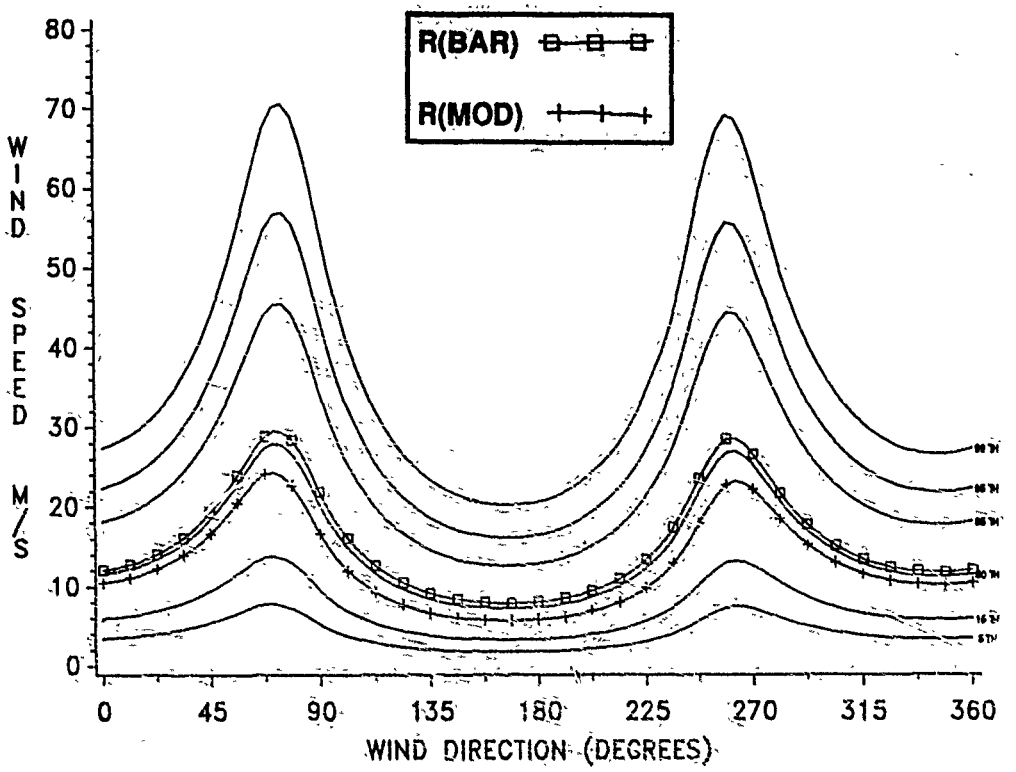


**Figure E-63. Conditional Wind Speed Given Direction, January, 30 KM.**

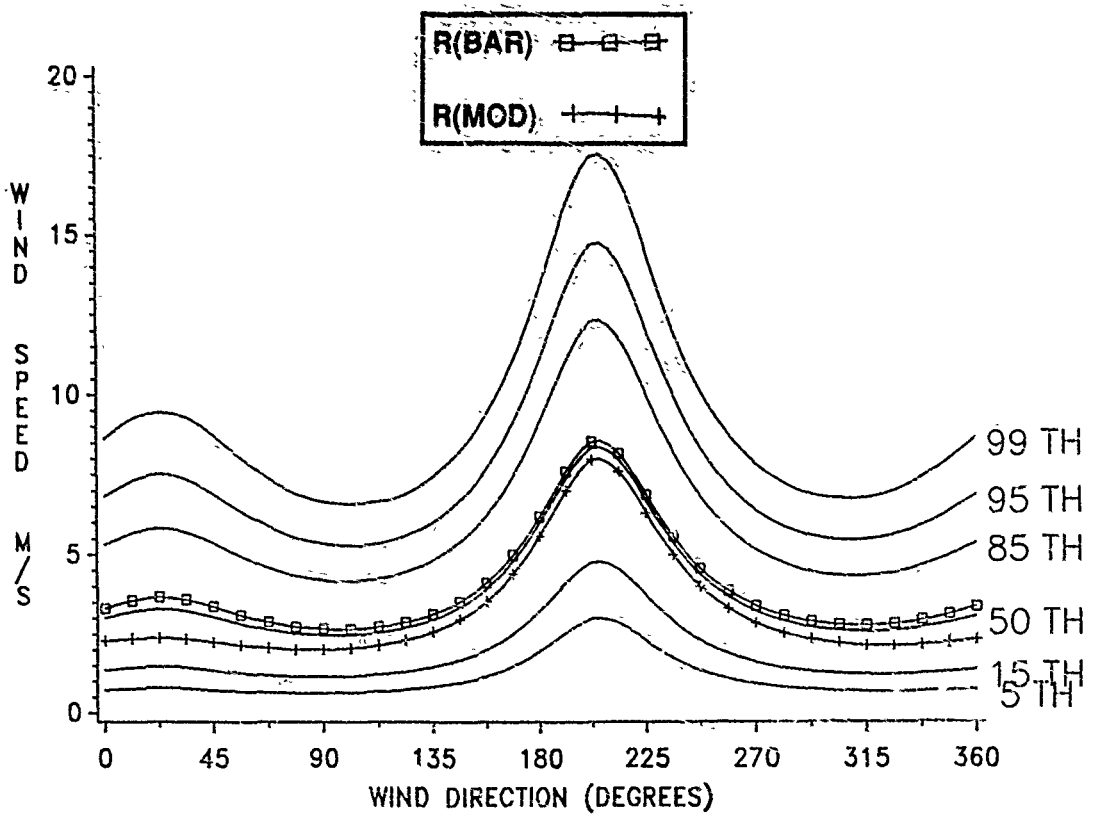


**Figure E-64. Conditional Wind Speed Given Direction, July, 2 KM.**

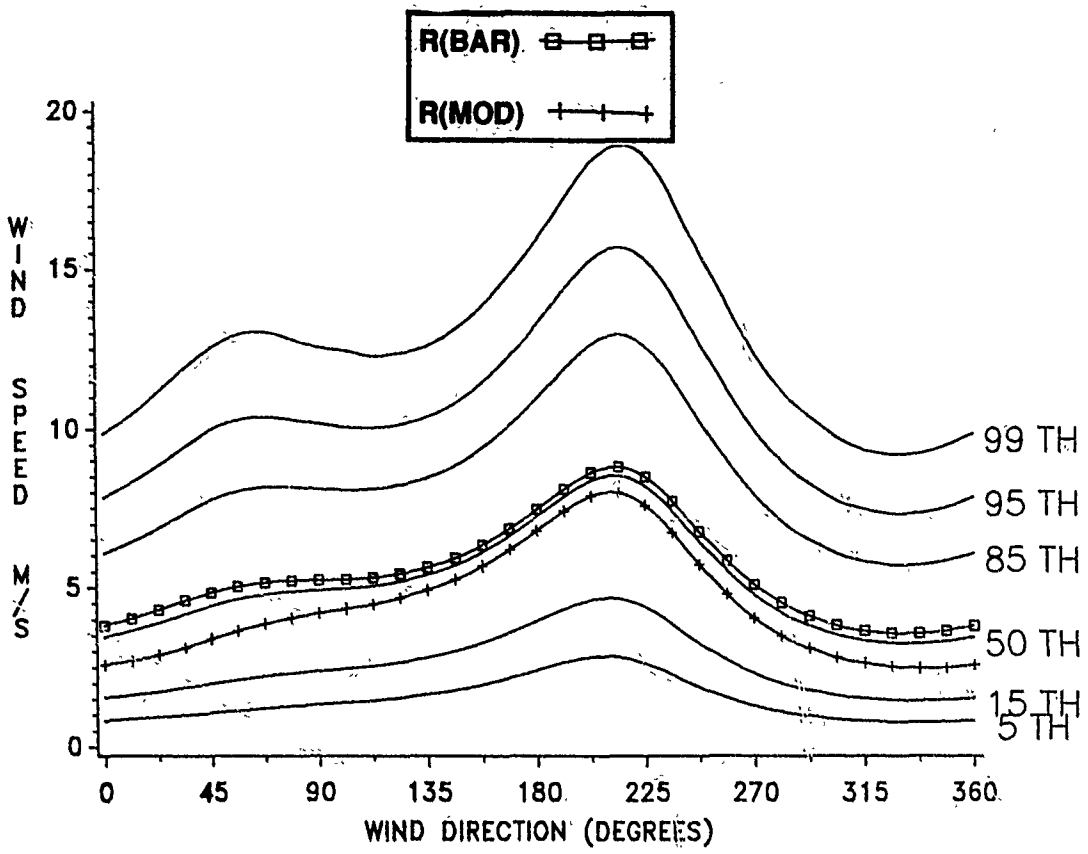


**Figure E-65. Conditional Wind Speed Given Direction, July, 4 KM.**

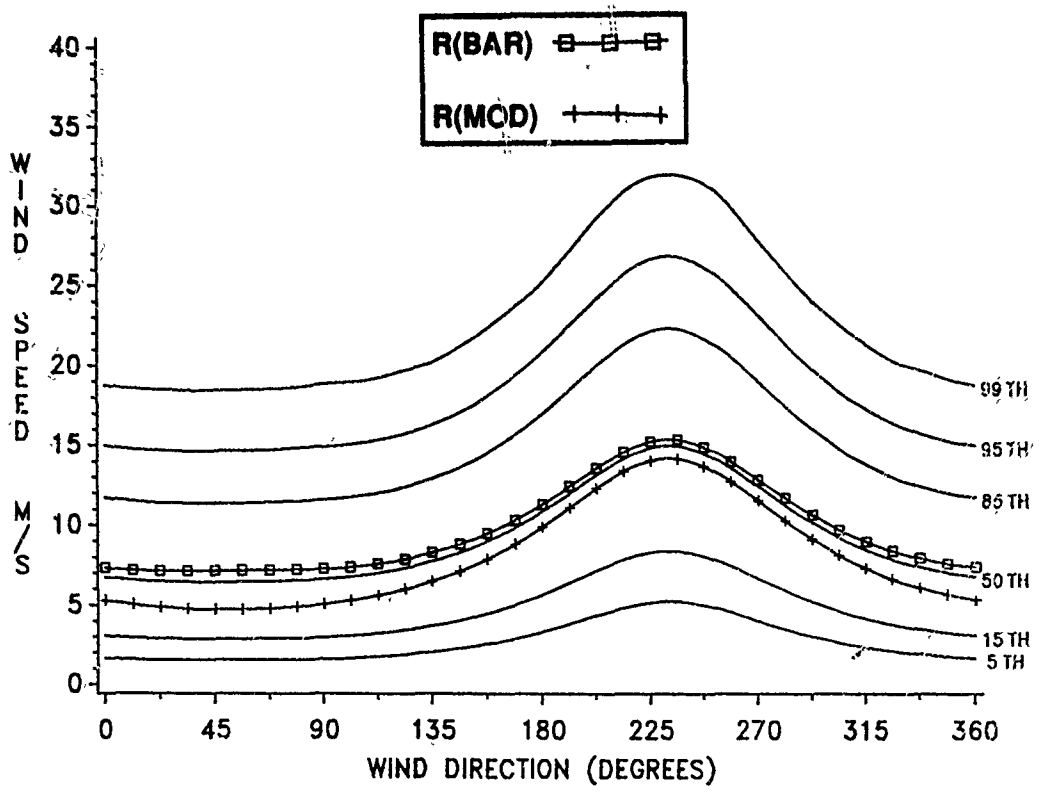


**Figure E-66. Conditional Wind Speed Given Direction, July, 8 KM.**

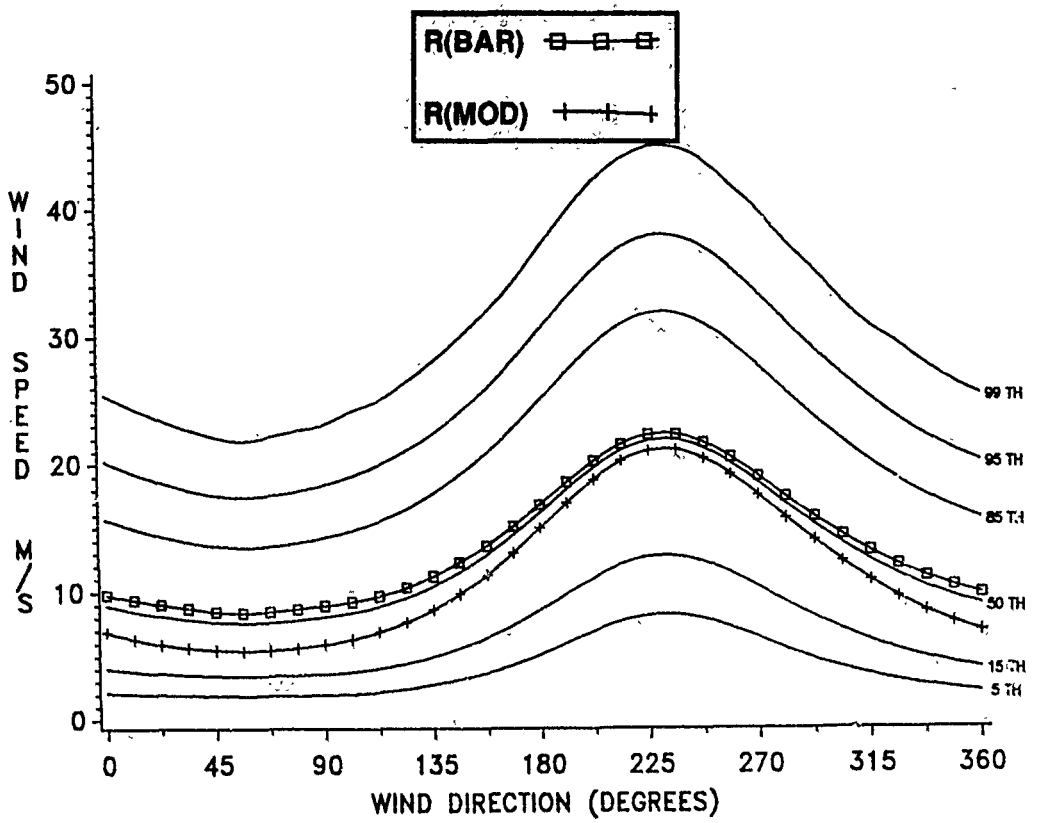


**Figure E-67. Conditional Wind Speed Given Direction, July, 12 KM.**

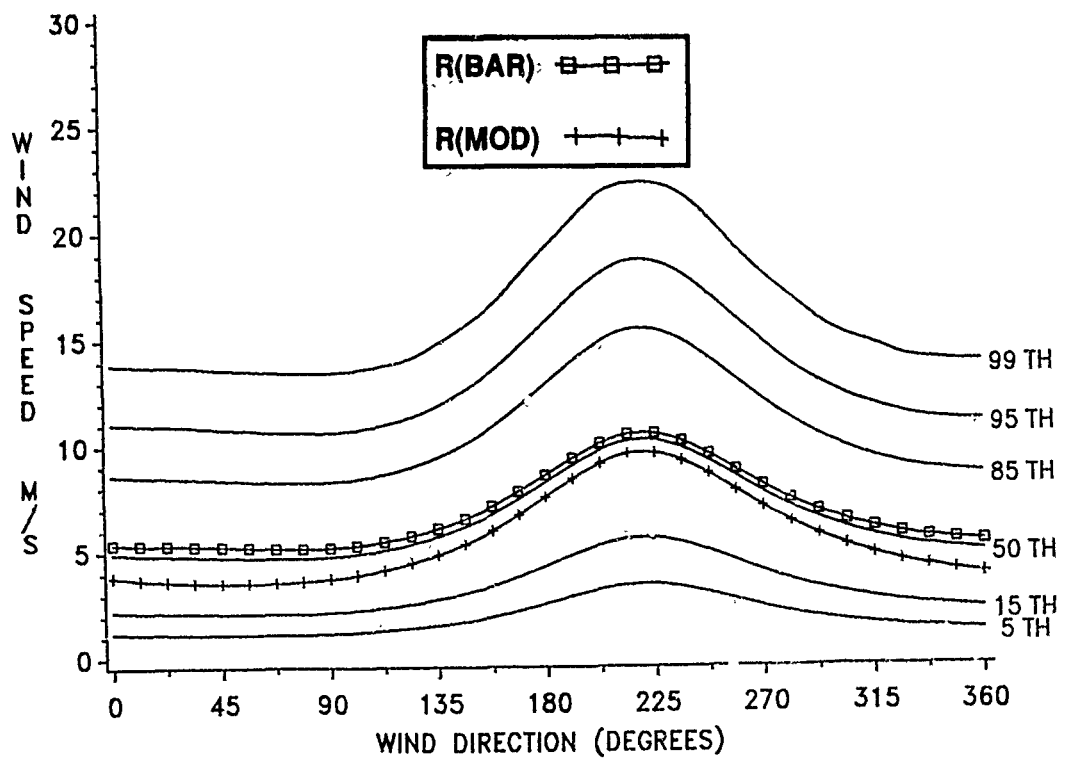


**Figure E-68. Conditional Wind Speed Given Direction, July, 16 KM.**

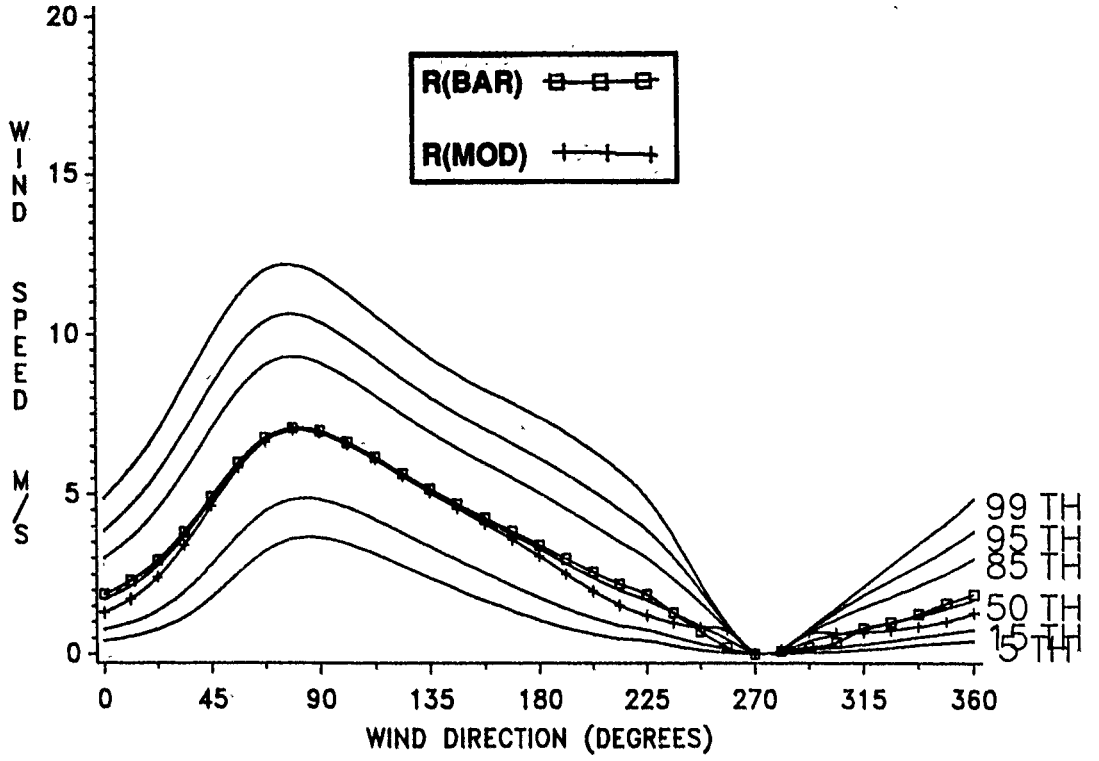


**Figure E-69. Conditional Wind Speed Given Direction, July, 20 KM.**

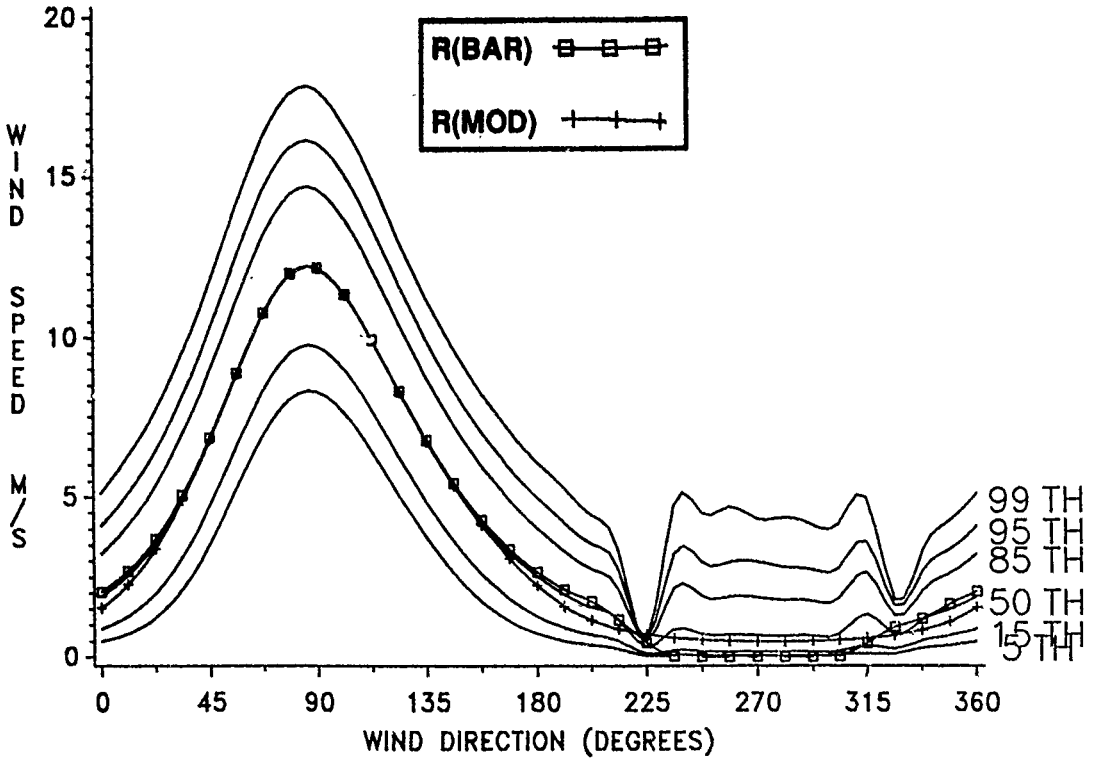


**Figure E-70. Conditional Wind Speed Given Direction, July, 24 KM.**

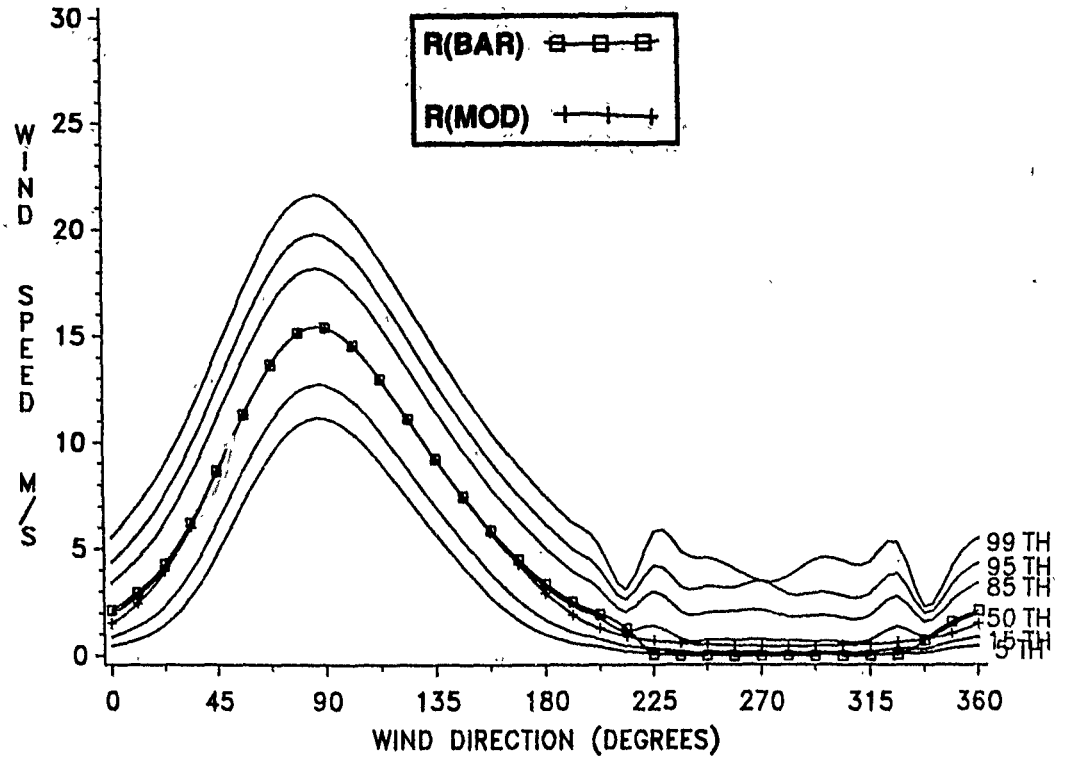


**Figure E-71. Conditional Wind Speed Given Direction, July, 28 KM.**

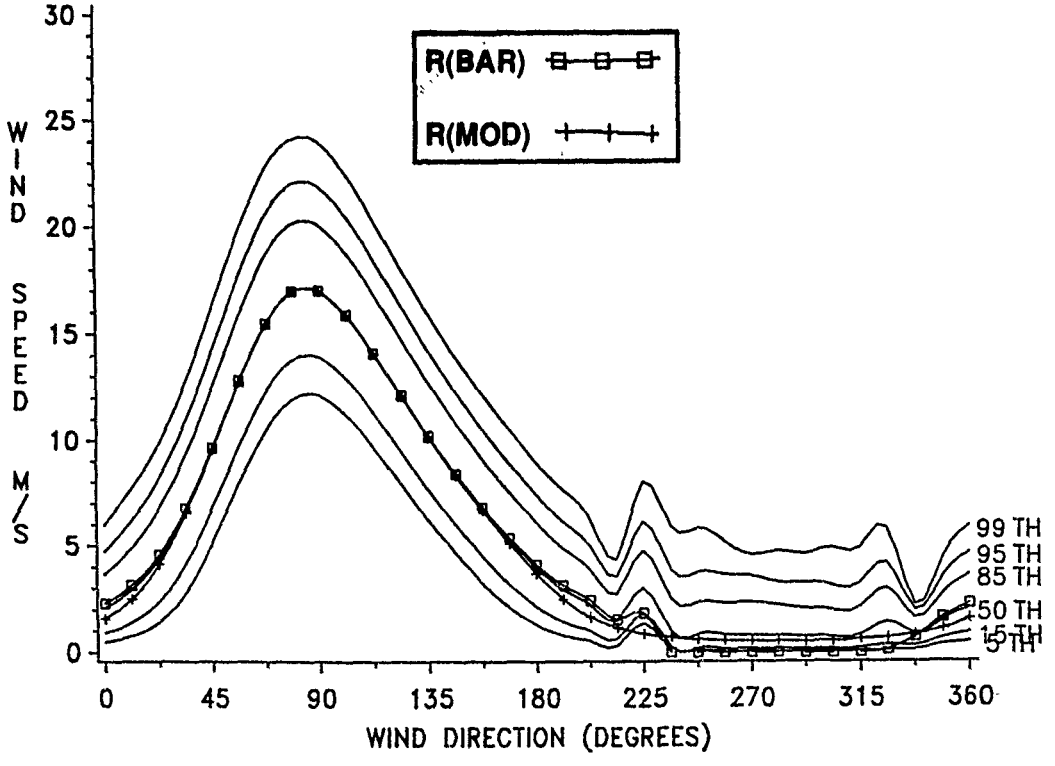


**Figure E-72. Conditional Wind Speed Given Direction, July, 30 KM.**

# APPENDIX F

## Thermodynamic Statistics Derivable from Appendix B, C, and D Tables

This appendix gives graphic examples of certain pressure, density, and virtual temperature statistics that can be derived from basic data in Appendices B, C, and D. These examples should help RRA users in understanding and visualizing the relationships that can be inferred from data in Appendices B and D.

### Monthly Means from the Annual Mean

The hydrostatic model values in Appendix D are used to compute monthly mean differences relative to annual mean values of pressure, density, and virtual temperature (expressed in percent), and the monthly mean difference in virtual temperature for annual mean virtual temperature (expressed in kelvin, K). Examples of these four statistics are given in Tables F-1 (January) and F-2 (July); graphic displays of the four statistics contained in these tables are then provided by Figures F-1 through F-8. The relative differences between monthly mean values (from Tables D-1 through D-12 for all months) and annual mean values (Table D-13) are illustrated in Figures F-9 and F-18 for pressure, Figures F-10 and F-12 for density, and Figures F-13 and F-14 for virtual temperature. Differences between monthly mean virtual temperature differences and annual mean virtual temperature for all months are given in Figures F-15 and F-16.

### Coefficients of Variation and Derived Correlation Coefficients.

The coefficient of variation ($C_V$) is defined as "the standard deviation with respect to the mean divided by the mean." Coefficients of variation for pressure ($C_VP$) and density ($C_VD$) were computed using standard deviations in Appendix B and the hydrostatic mean values in Appendix E. The coefficient of variation for temperature uses the standard deviations of virtual temperature from Appendix C to the altitude at which virtual temperature exists; above that altitude, standard deviations of temperature are from Appendix B. Mean values for virtual temperature to the altitude at which it exists and above are taken from Appendix E. No distinction is made between virtual temperature and temperature in Table F-3, Table F-4, or any of the figures.

From the coefficients of variation for pressure and temperature (virtual temperature to the altitude at which it exists), correlation coefficients between these quantities are derived using Buell's method--see Chapter 3. The three equations for the derived correlation coefficients in Tables F-3 and F-4 are:

$$R(P,T) = \frac{(C_VT)^2 + (C_VP)^2 - (C_VD)^2}{2|C_VT \cdot C_VP|} \qquad \text{(F-1)}$$

$$R(P,D) = \frac{(C_VD)^2 - (C_VT)^2 + (C_VP)^2}{2|C_VD \cdot C_VP|} \qquad \text{(F-2)}$$

$$R(T,D) = \frac{(C_V P)^2 + (C_V D)^2 - (C_V T)^2}{2[C_V T \cdot C_V D]} \qquad \text{(F-3)}$$

To test for validity of derived correlation coefficients, all three of the following inequalities must be satisfied:

$$\begin{aligned} C_V P - (C_V D + C_V T) &< 0 \\ C_V D - (C_V T + C_V P) &< 0 \\ C_V T - (C_V P + C_V D) &< 0 \end{aligned} \qquad \text{(F-4)}$$

In the examples (Tables F-3 and F-4), the numerical values from equation F-4 are usually negative, and the derived correlation test is considered valid. However, when any of the inequalities are not satisfied, "9.999" (missing) is written in the table. The rare exceptions to this test for several RRAs occur at extremely high altitudes where sample sizes for the statistical sample are small.

Statistical parameters from Table F-3 (January) and Table F-4 (July) are illustrated in Figures F-17 through F-20.

$C_V P$ values for all months are given in Figures F-21 and F-22. $C_V D$ values are given in Figures F-23 and F-24, and $C_V T$ values in Figures F-25 and F-26. If the abscissa on the figures for the coefficient of variation is multiplied by 100, these figures would show the percentage of random dispersion for these quantities over the month with respect to the monthly mean.

Derived correlation coefficients for all months are shown as follows: Figures F-27 and F-28 give *R(P,D)*; Figures F-29 and F-30 give *R(P,T)*; and Figures F-31 and F-32 give *R(T,D)*.

## TABLE F-1. Deltas in Percent Relative to Annual, Nellis, January.

| RLEVEL | PRESSURE | DENSITY | TEMP. | TMO-TANN(K) |
|---|---|---|---|---|
| 0.000 | 0.784 | 4.893 | -3.917 | -11.670 |
| 1.000 | 0.333 | 3.975 | -3.501 | -10.210 |
| 1.007 | 0.344 | 3.978 | -3.494 | -10.190 |
| 2.000 | -0.039 | 3.176 | -3.115 | -8.890 |
| 3.000 | -0.394 | 2.040 | -2.383 | -6.630 |
| 4.000 | -0.675 | 1.363 | -2.009 | -5.450 |
| 5.000 | -0.931 | 1.056 | -1.966 | -5.200 |
| 6.000 | -1.205 | 0.826 | -2.015 | -5.190 |
| 7.000 | -1.467 | 0.497 | -1.951 | -4.890 |
| 8.000 | -1.770 | 0.229 | -1.993 | -4.870 |
| 9.000 | -2.065 | -0.235 | -1.834 | -4.400 |
| 10.000 | -2.436 | 3.296 | -5.551 | -13.140 |
| 11.000 | -2.732 | 4.276 | -6.721 | -15.750 |
| 12.000 | -2.905 | -2.185 | -0.738 | -1.610 |
| 13.000 | -2.938 | -3.276 | 0.348 | 0.750 |
| 14.000 | -2.869 | -3.775 | 0.945 | 2.020 |
| 15.000 | -2.733 | -3.663 | 0.965 | 2.040 |
| 16.000 | -2.572 | -3.222 | 0.672 | 1.410 |
| 17.000 | -2.553 | -2.838 | 0.291 | 0.610 |
| 18.000 | -2.524 | -2.404 | -0.124 | -0.260 |
| 19.000 | -2.576 | -2.112 | -0.473 | -1.000 |
| 20.000 | -2.688 | -1.961 | -0.741 | -1.580 |
| 21.000 | -2.807 | -1.842 | -0.983 | -2.110 |
| 22.000 | -3.014 | -1.889 | -1.148 | -2.480 |
| 23.000 | -3.238 | -1.908 | -1.352 | -2.940 |
| 24.000 | -3.419 | -1.906 | -1.544 | -3.380 |
| 25.000 | -3.683 | -1.973 | -1.747 | -3.850 |
| 26.000 | -3.911 | -2.106 | -1.844 | -4.090 |
| 27.000 | -4.211 | -2.277 | -1.975 | -4.410 |
| 28.000 | -4.483 | -2.489 | -2.047 | -4.600 |
| 29.000 | -4.713 | -2.646 | -2.121 | -4.800 |
| 30.000 | -4.762 | -2.859 | -1.958 | -4.460 |

## TABLE F-2. Deltas in Percent Relative to Annual, Nellis, July.

| RLEVEL | PRESSURE | DENSITY | TEMP. | TMO-TANN(K) |
|---|---|---|---|---|
| 0.000 | -0.581 | -4.637 | 4.253 | 12.670 |
| 1.000 | -0.105 | -4.022 | 4.081 | 11.900 |
| 1.007 | -0.093 | -4.009 | 4.081 | 11.900 |
| 2.000 | 0.348 | -3.413 | 3.896 | 11.120 |
| 3.000 | 0.789 | -2.621 | 3.501 | 9.740 |
| 4.000 | 1.209 | -1.881 | 3.152 | 8.550 |
| 5.000 | 1.602 | -1.347 | 2.990 | 7.910 |
| 6.000 | 2.020 | -1.018 | 3.066 | 7.900 |
| 7.000 | 2.418 | -0.743 | 3.188 | 7.990 |
| 8.000 | 2.903 | -0.028 | 2.934 | 7.170 |
| 9.000 | 3.357 | 1.612 | 1.717 | 4.120 |
| 10.000 | 3.966 | 3.751 | 0.207 | 0.490 |
| 11.000 | 4.473 | 4.227 | 0.235 | 0.550 |
| 12.000 | 4.801 | 2.731 | 2.016 | 4.400 |
| 13.000 | 5.021 | 4.567 | 0.436 | 0.940 |
| 14.000 | 4.987 | 6.086 | -1.034 | -2.210 |
| 15.000 | 4.800 | 6.669 | -1.754 | -3.710 |
| 16.000 | 4.499 | 6.255 | -1.654 | -3.470 |
| 17.000 | 4.302 | 5.433 | -1.074 | -2.250 |
| 18.000 | 4.191 | 4.636 | -0.423 | -0.890 |
| 19.000 | 4.139 | 3.920 | 0.213 | 0.450 |
| 20.000 | 4.247 | 3.517 | 0.709 | 1.510 |
| 21.000 | 4.305 | 3.242 | 1.025 | 2.200 |
| 22.000 | 4.509 | 3.195 | 1.273 | 2.750 |
| 23.000 | 4.725 | 3.281 | 1.398 | 3.040 |
| 24.000 | 4.853 | 3.325 | 1.480 | 3.240 |
| 25.000 | 5.138 | 3.461 | 1.620 | 3.570 |
| 26.000 | 5.396 | 3.612 | 1.722 | 3.820 |
| 27.000 | 5.519 | 3.653 | 1.800 | 4.020 |
| 28.000 | 5.751 | 3.814 | 1.864 | 4.190 |
| 29.000 | 5.863 | 3.891 | 1.900 | 4.300 |
| 30.000 | 6.036 | 4.062 | 1.897 | 4.3200 |

## TABLE F-3. Coefficients of Variation/Correlation Coefficients, January.

| LEVEL | CVP | CVD | CVT | R(P,T) | R(P,D) | R(T,D) |
|---|---|---|---|---|---|---|
| 0.000 | 0.008 | 0.040 | 0.035 | -0.478 | 0.622 | -0.985 |
| 1.000 | 0.007 | 0.023 | 0.022 | 0.066 | 0.220 | -0.959 |
| 1.007 | 0.007 | 0.023 | 0.022 | -0.031 | 0.315 | -0.958 |
| 2.000 | 0.007 | 0.016 | 0.018 | 0.458 | -0.067 | -0.918 |
| 3.000 | 0.009 | 0.015 | 0.020 | 0.751 | -0.436 | -0.922 |
| 4.000 | 0.011 | 0.013 | 0.021 | 0.858 | -0.553 | -0.903 |
| 5.000 | 0.013 | 0.011 | 0.021 | 0.898 | -0.546 | -0.859 |
| 6.000 | 0.016 | 0.010 | 0.022 | 0.908 | -0.391 | -0.741 |
| 7.000 | 0.019 | 0.009 | 0.022 | 0.888 | 0.246 | -0.229 |
| 8.000 | 0.021 | 0.011 | 0.020 | 0.913 | 0.858 | 0.573 |
| 9.000 | 0.024 | 0.015 | 0.017 | 9.999 | 9.999 | 9.999 |
| 10.000 | 0.025 | 0.023 | 0.016 | 0.423 | 0.781 | -0.236 |
| 11.000 | 0.025 | 0.034 | 0.020 | -0.122 | 0.816 | -0.674 |
| 12.000 | 0.024 | 0.042 | 0.026 | -0.412 | 0.830 | -0.850 |
| 13.000 | 0.023 | 0.040 | 0.024 | -0.440 | 0.838 | -0.859 |
| 14.000 | 0.021 | 0.034 | 0.018 | -0.444 | 0.874 | -0.823 |
| 15.000 | 0.020 | 0.032 | 0.017 | -0.520 | 0.892 | -0.850 |
| 16.000 | 0.018 | 0.032 | 0.018 | -0.565 | 0.884 | -0.885 |
| 17.000 | 0.017 | 0.030 | 0.018 | -0.445 | 0.837 | -0.863 |
| 18.000 | 0.016 | 0.027 | 0.018 | -0.227 | 0.744 | -0.820 |
| 19.000 | 0.016 | 0.023 | 0.018 | 0.054 | 0.629 | -0.742 |
| 20.000 | 0.016 | 0.020 | 0.018 | 0.353 | 0.501 | -0.632 |
| 21.000 | 0.017 | 0.016 | 0.018 | 0.577 | 0.415 | -0.504 |
| 22.000 | 0.019 | 0.016 | 0.019 | 0.677 | 0.407 | -0.397 |
| 23.000 | 0.022 | 0.015 | 0.019 | 0.732 | 0.486 | -0.239 |
| 24.000 | 0.023 | 0.016 | 0.020 | 0.747 | 0.561 | -0.130 |
| 25.000 | 0.026 | 0.018 | 0.020 | 0.724 | 0.633 | -0.078 |
| 26.000 | 0.027 | 0.020 | 0.020 | 0.685 | 0.698 | -0.046 |
| 27.000 | 0.029 | 0.022 | 0.019 | 0.649 | 0.741 | -0.030 |
| 28.000 | 0.030 | 0.025 | 0.020 | 0.573 | 0.747 | -0.117 |
| 29.000 | 0.031 | 0.027 | 0.021 | 0.510 | 0.736 | -0.206 |
| 30.000 | 0.032 | 0.030 | 0.023 | 0.448 | 0.734 | -0.278 |

## TABLE F-4. Coefficients of Variation/Correlation Coefficient, July.

| LEVEL | CVP | CVD | CVT | R(P,T) | R(P,D) | R(T,D) |
|---|---|---|---|---|---|---|
| 0.000 | 0.005 | 0.043 | 0.038 | -0.916 | 0.934 | -0.999 |
| 1.000 | 0.003 | 0.024 | 0.024 | -0.277 | 0.381 | -0.994 |
| 1.007 | 0.003 | 0.024 | 0.023 | -0.212 | 0.322 | -0.993 |
| 2.000 | 0.003 | 0.011 | 0.012 | 0.269 | -0.028 | -0.971 |
| 3.000 | 0.003 | 0.008 | 0.010 | 0.608 | -0.326 | -0.949 |
| 4.000 | 0.004 | 0.007 | 0.009 | 0.671 | -0.231 | -0.876 |
| 5.000 | 0.005 | 0.006 | 0.008 | 0.675 | -0.040 | -0.764 |
| 6.000 | 0.006 | 0.006 | 0.008 | 0.673 | 0.060 | -0.699 |
| 7.000 | 0.006 | 0.006 | 0.009 | 0.717 | -0.007 | -0.702 |
| 8.000 | 0.007 | 0.006 | 0.010 | 0.758 | 0.007 | -0.648 |
| 9.000 | 0.008 | 0.007 | 0.010 | 0.748 | 0.103 | -0.583 |
| 10.000 | 0.010 | 0.007 | 0.010 | 0.672 | 0.569 | -0.227 |
| 11.000 | 0.011 | 0.009 | 0.010 | 0.640 | 0.522 | -0.321 |
| 12.000 | 0.011 | 0.011 | 0.010 | 0.540 | 0.546 | -0.410 |
| 13.000 | 0.012 | 0.015 | 0.010 | 0.099 | 0.720 | -0.619 |
| 14.000 | 0.012 | 0.019 | 0.013 | -0.192 | 0.746 | -0.796 |
| 15.000 | 0.011 | 0.022 | 0.015 | -0.336 | 0.752 | -0.873 |
| 16.000 | 0.010 | 0.021 | 0.016 | -0.350 | 0.733 | -0.894 |
| 17.000 | 0.010 | 0.017 | 0.013 | -0.141 | 0.658 | -0.838 |
| 18.000 | 0.010 | 0.014 | 0.011 | 0.117 | 0.585 | -0.737 |
| 19.000 | 0.010 | 0.011 | 0.009 | 0.268 | 0.638 | -0.571 |
| 20.000 | 0.010 | 0.010 | 0.008 | 0.428 | 0.692 | -0.356 |
| 21.000 | 0.011 | 0.009 | 0.008 | 0.539 | 0.714 | -0.206 |
| 22.000 | 0.012 | 0.010 | 0.008 | 0.583 | 0.717 | -0.148 |
| 23.000 | 0.012 | 0.010 | 0.008 | 0.612 | 0.788 | -0.005 |
| 24.000 | 0.013 | 0.010 | 0.008 | 0.688 | 0.820 | 0.148 |
| 25.000 | 0.014 | 0.010 | 0.008 | 0.705 | 0.835 | 0.199 |
| 26.000 | 0.015 | 0.011 | 0.008 | 0.720 | 0.849 | 0.244 |
| 27.000 | 0.016 | 0.011 | 0.009 | 0.712 | 0.837 | 0.212 |
| 28.000 | 0.017 | 0.012 | 0.009 | 0.728 | 0.858 | 0.274 |
| 29.000 | 0.018 | 0.014 | 0.010 | 0.666 | 0.841 | 0.158 |
| 30.000 | 0.019 | 0.014 | 0.010 | 0.657 | 0.856 | 0.173 |

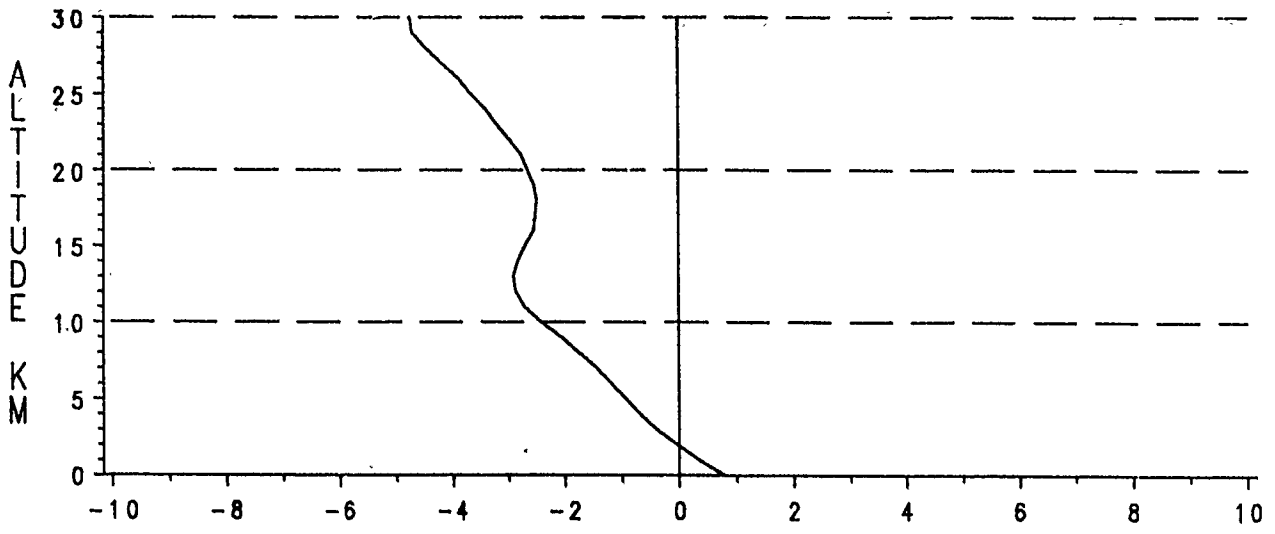


**Figure F-1. Delta Percent Relative to Annual Pressure, January.**

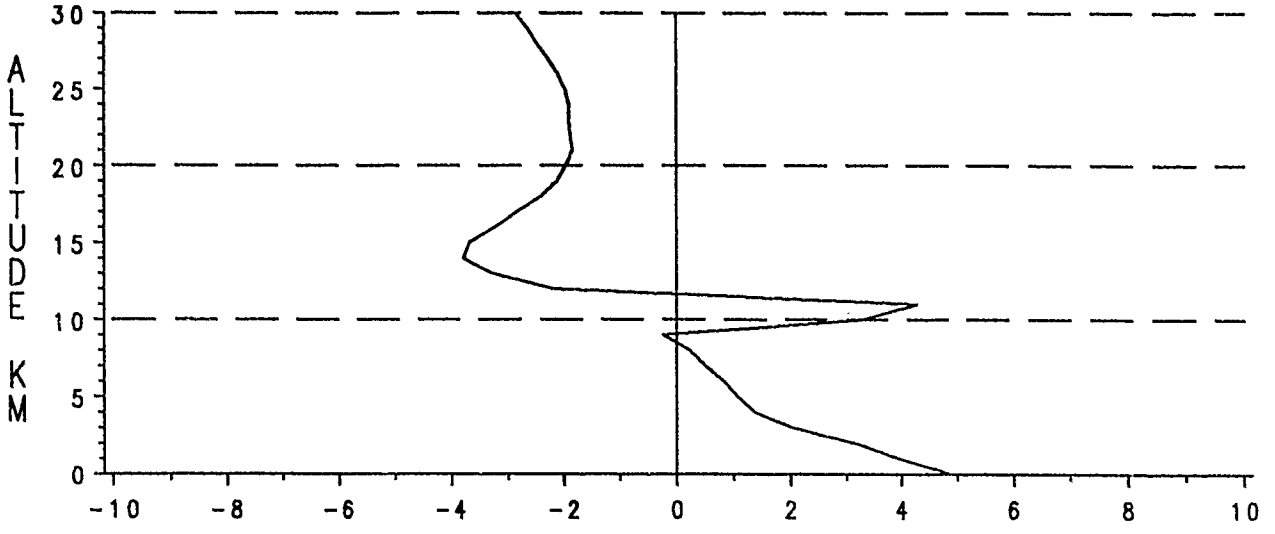


**Figure F-2. Delta Percent Relative to Annual Density, January.**

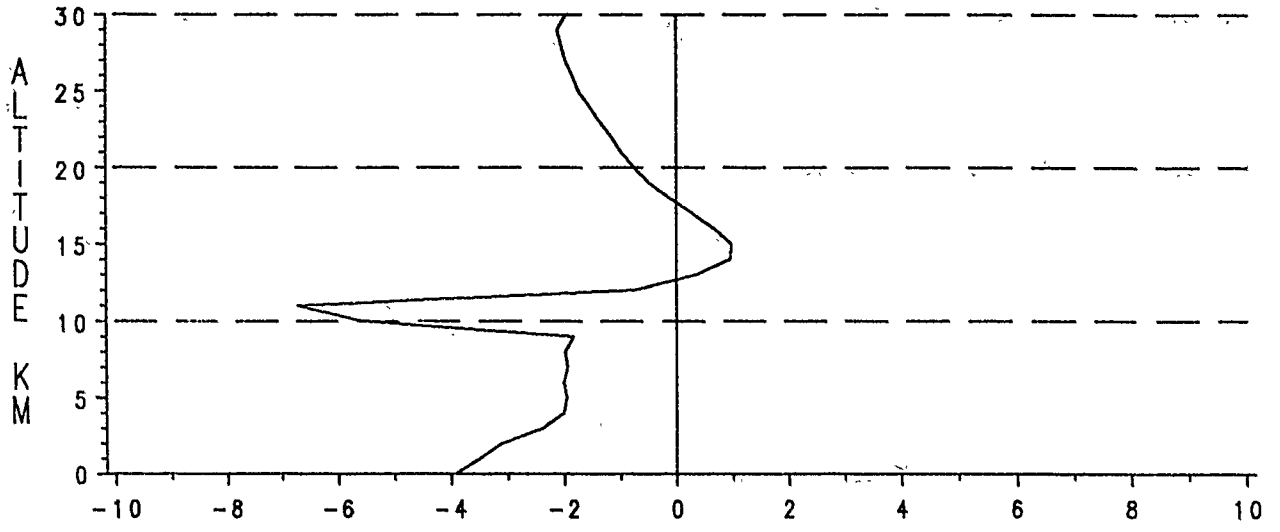


**Figure F-3. Delta Percent Relative to Annual Temperature, January.**

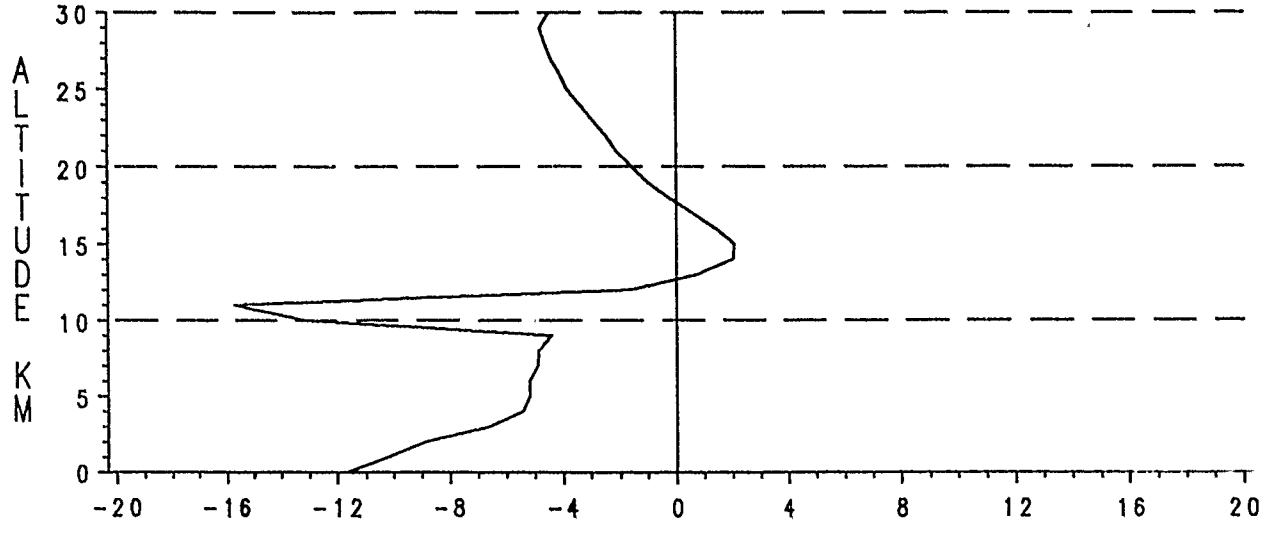


**Figure F-4. Delta Temperature (K), January.**

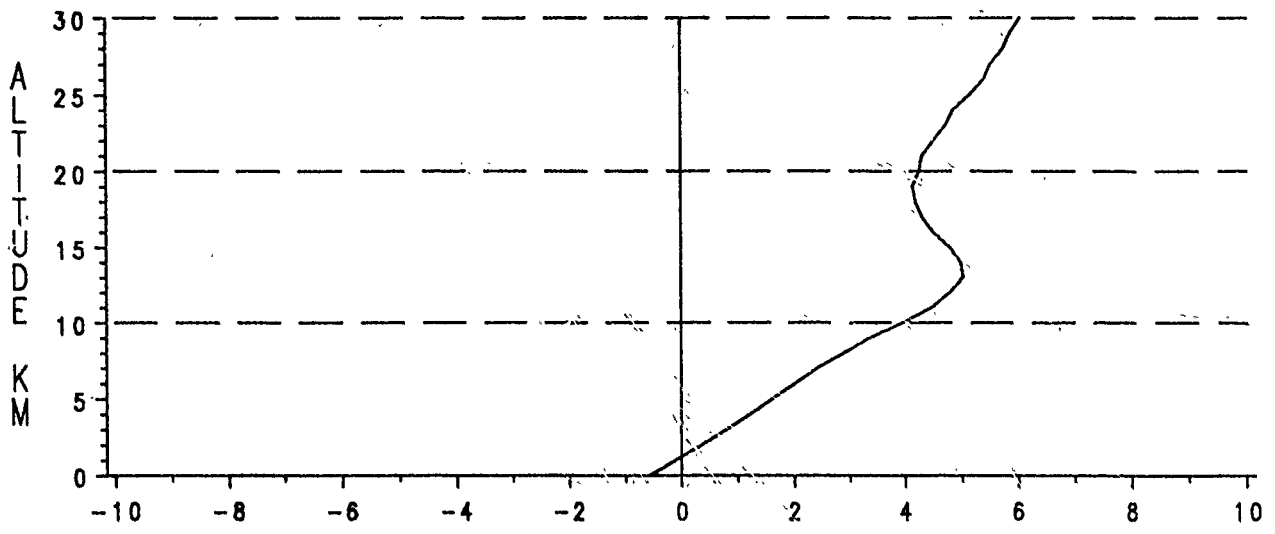


**Figure F-5. Delta Percent Relative to Annual Pressure, July.**

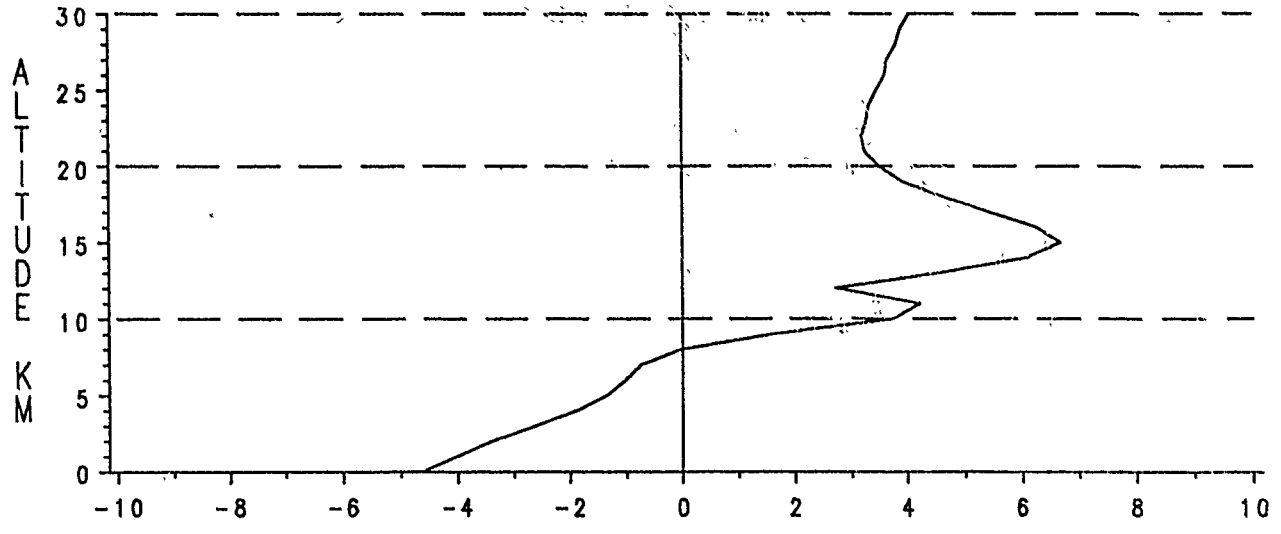


**Figure F-6. Delta Percent Relative to Annual Density, July.**

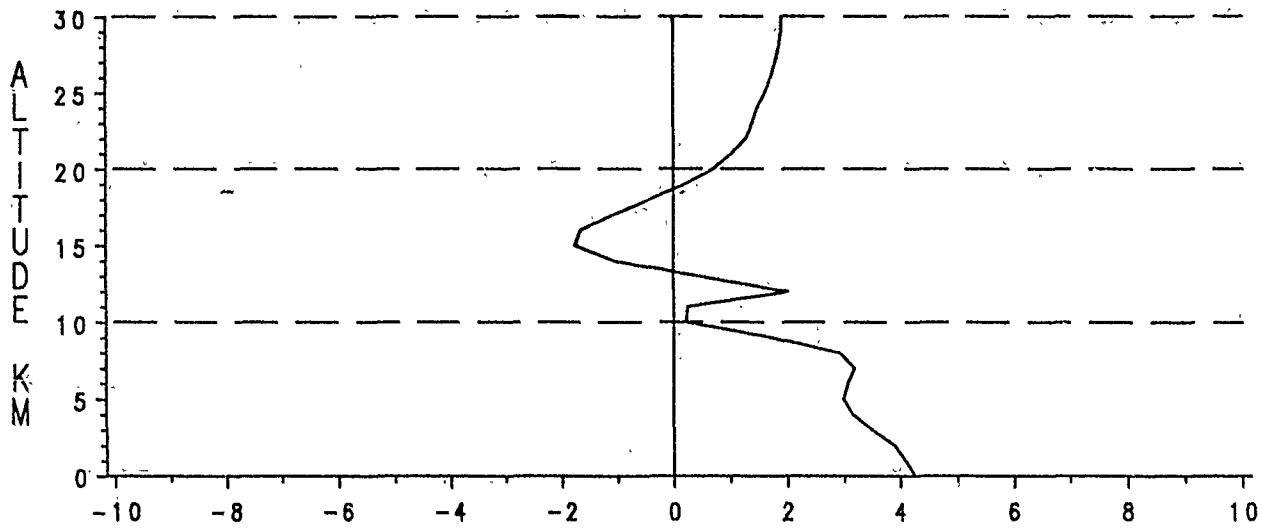


**Figure F-7. Delta Percent Relative to Annual Temperature, July.**

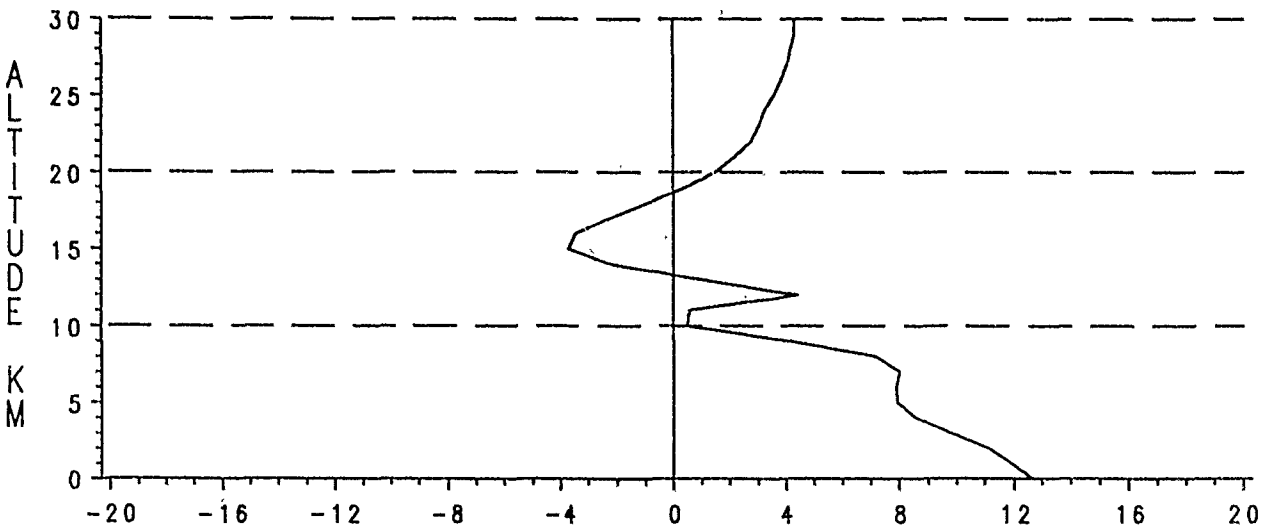


**Figure F-8. Delta Temperature (K), July.**

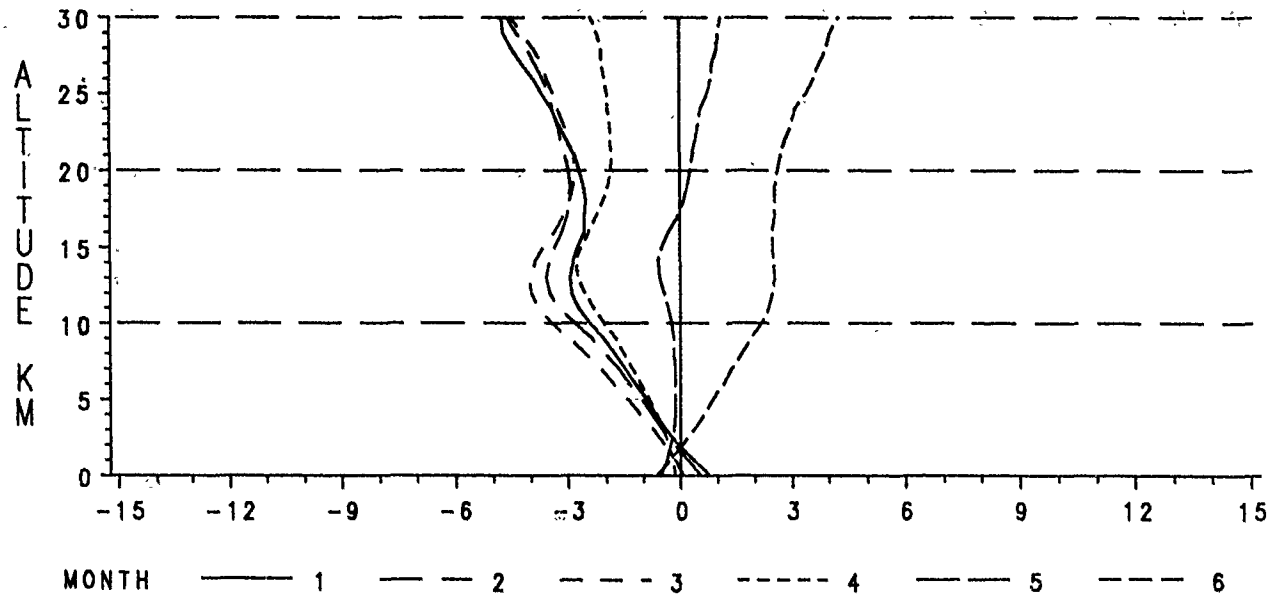


**Figure F-9. Delta Percent Relative to Annual Pressure, January-June.**

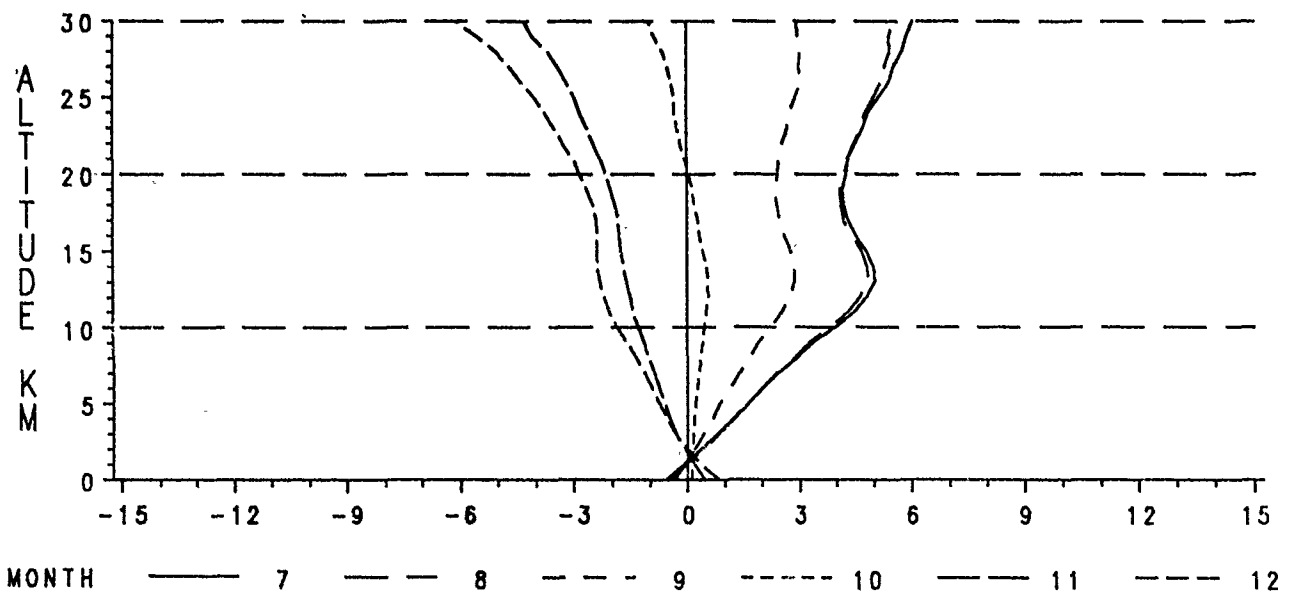


**Figure F-10. Delta Percent Relative to Annual Pressure, July-December.**

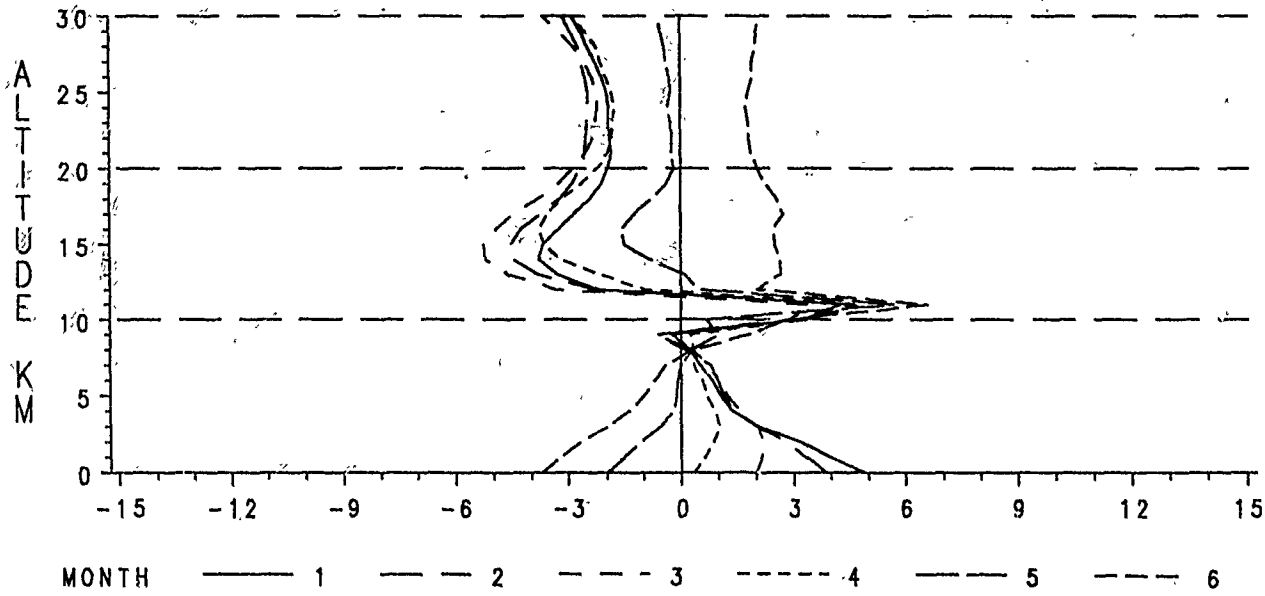


**Figure F-11. Delta Percent Relative to Annual Density, January-June.**

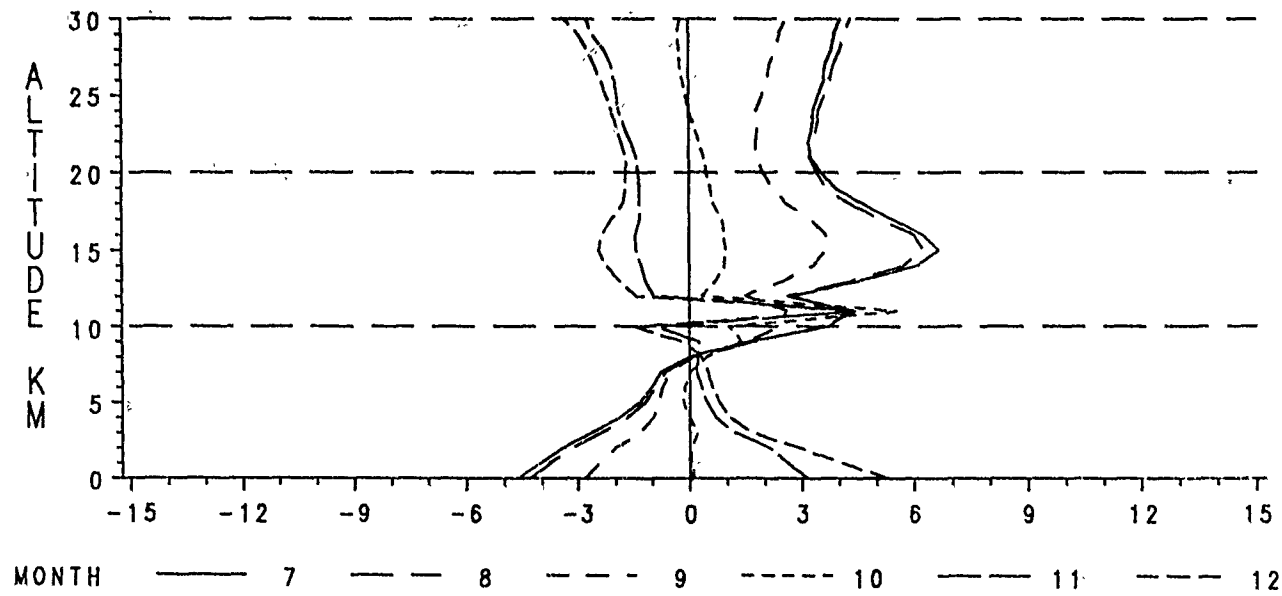


**Figure F-12. Delta Percent Relative to Annual Density, July-December.**

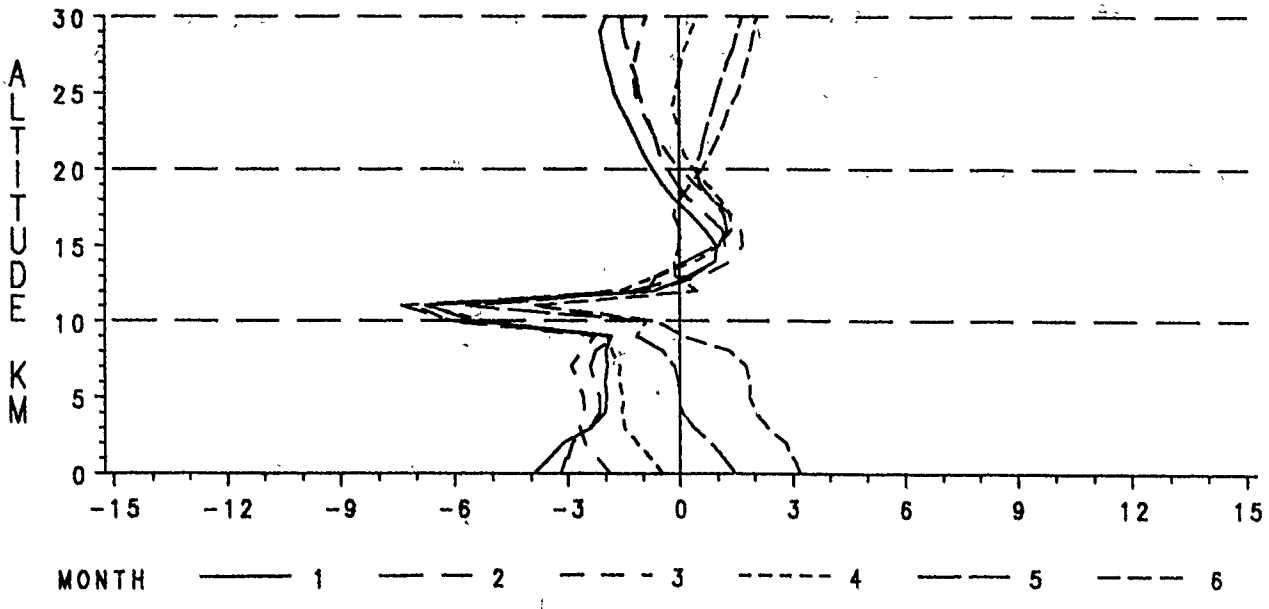


**Figure F-13. Delta Percent Relative to Annual Temperature, January-June.**

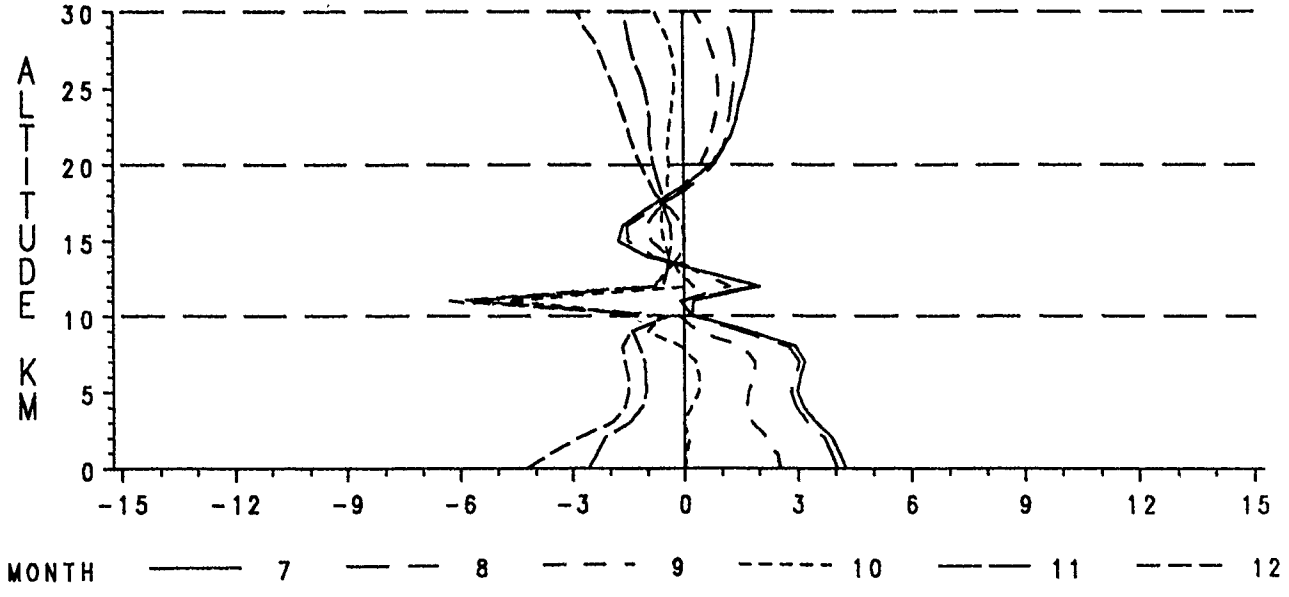


**Figure F-14. Delta Percent Relative to Annual Temperature, July-December.**

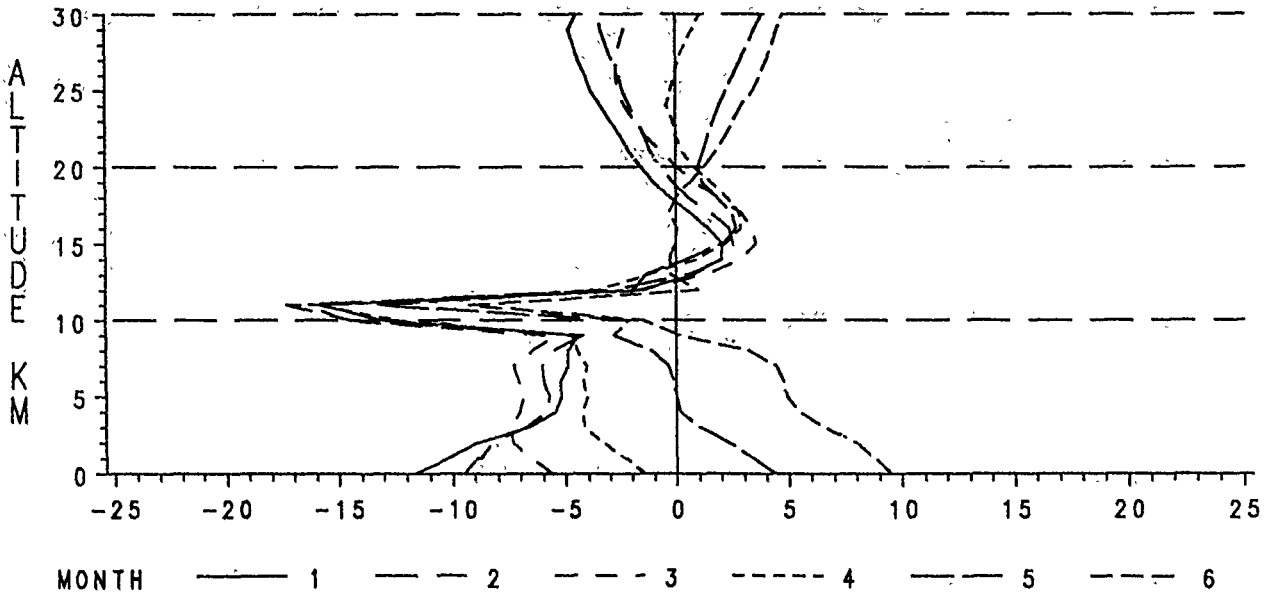


**Figure F-15. Delta Temperature (K), January-June.**

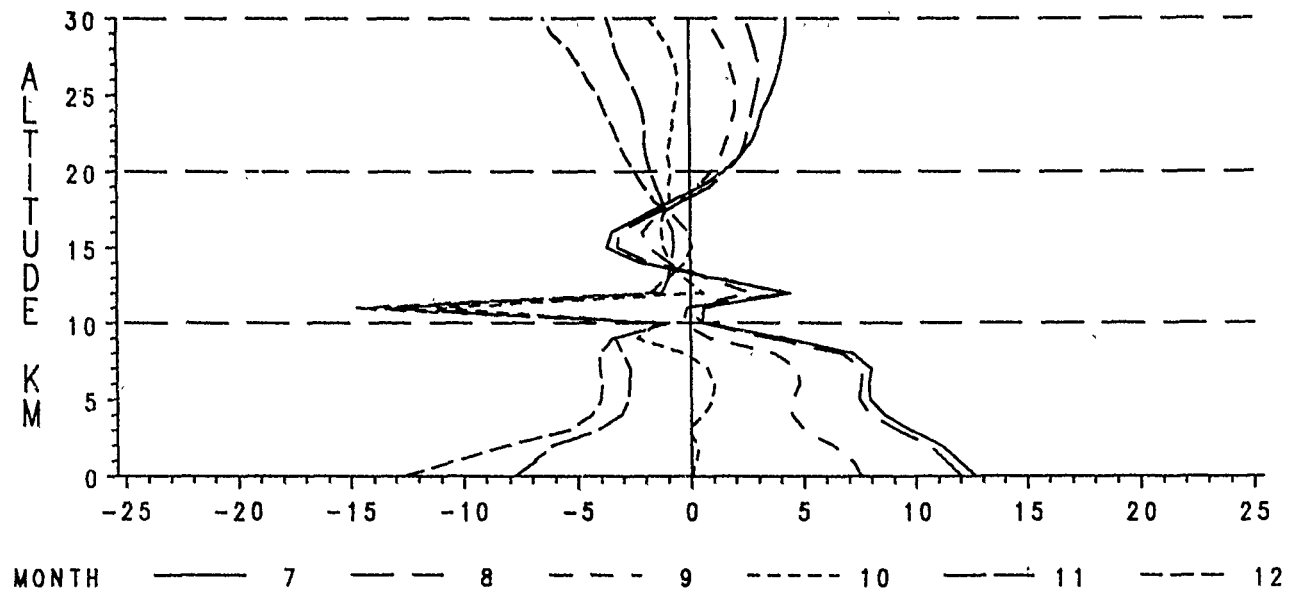


**Figure F-16 Delta Temperature (K), July-December.**

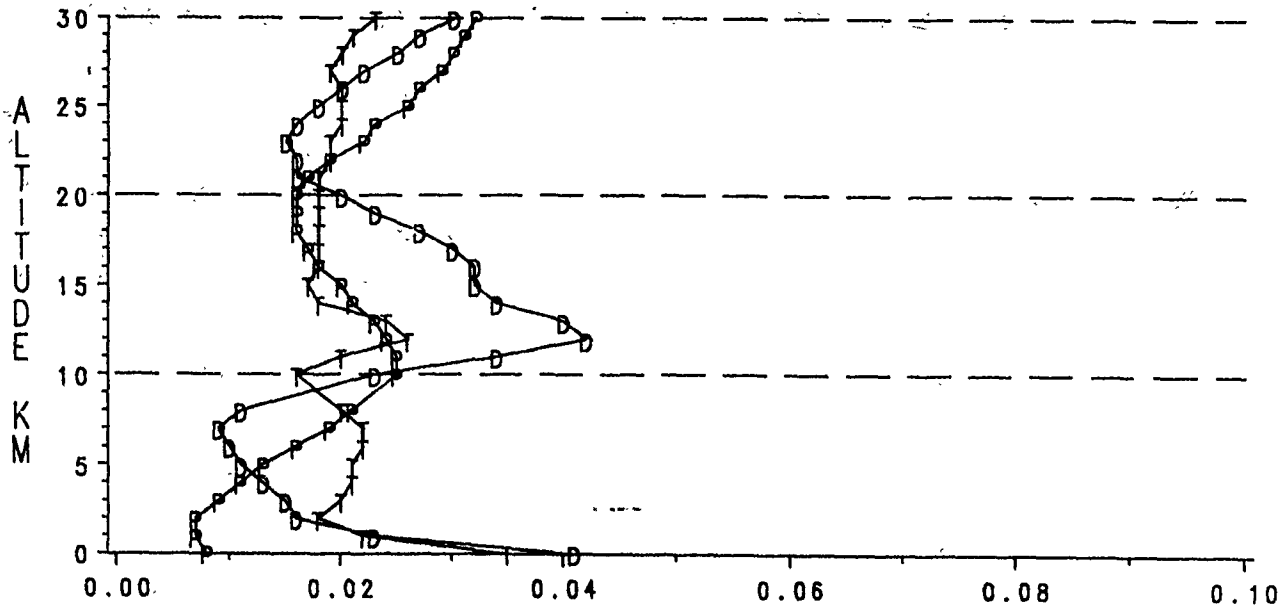


**Figure F-17. Coefficients of Variation for Pressure (P), Density (D), and Temperature (T), January.**

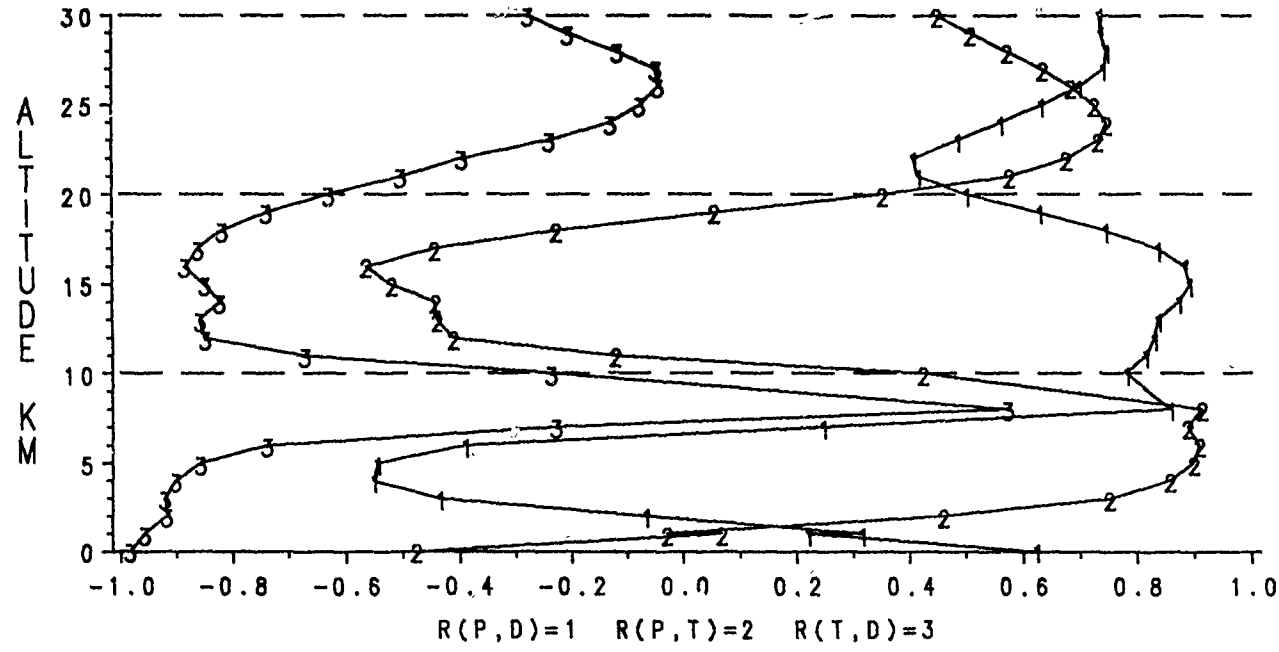


**Figure F-18. Correlation Coefficients for P&D, P&T, and T&D, January.**

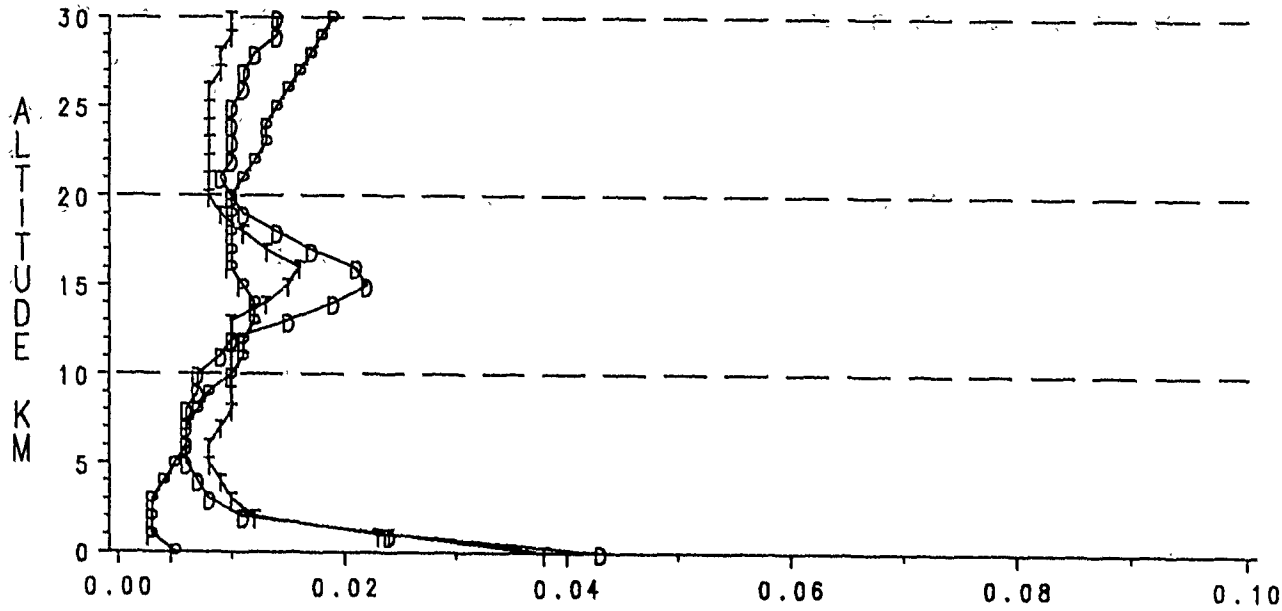


**Figure F-19. Coefficients of Variation for Pressure (P), Density (D), and Temperature (T), July.**

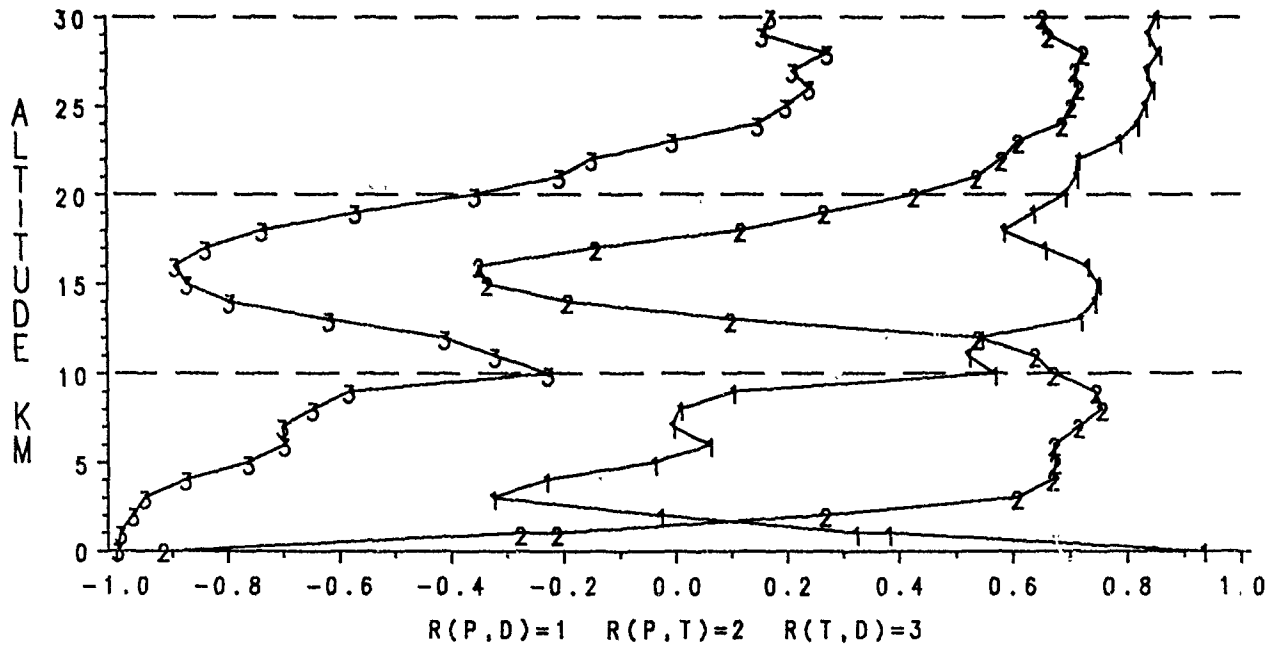


**Figure F-20. Correlation Coefficients for P&D, P&T, and T&D, July.**

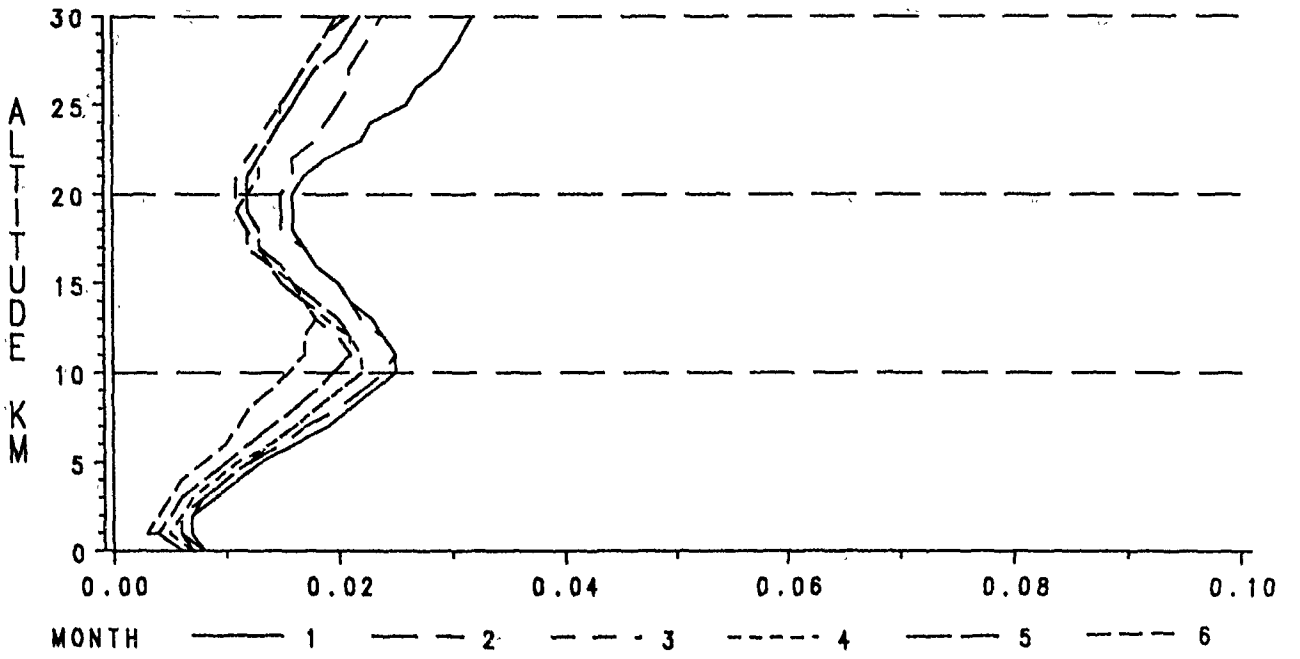


**Figure F-21. Coefficients of Variation for Pressure, January-June.**

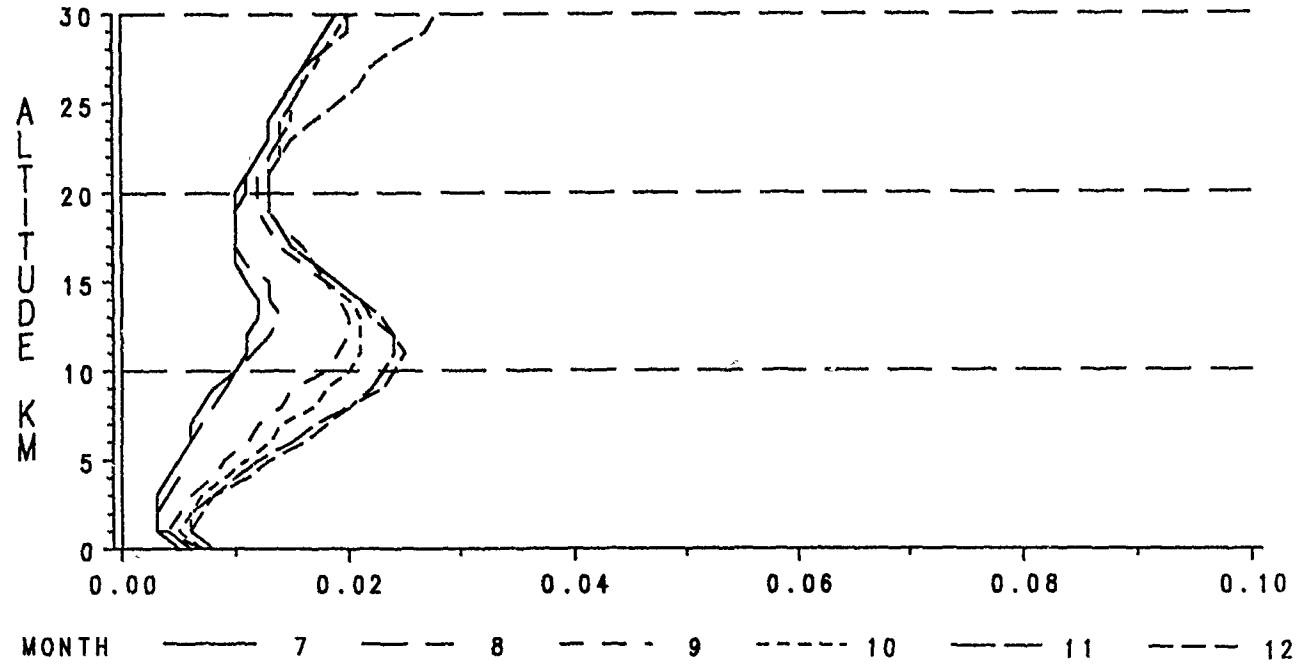


**Figure F-22. Coefficients of Variation for Pressure, July-December.**

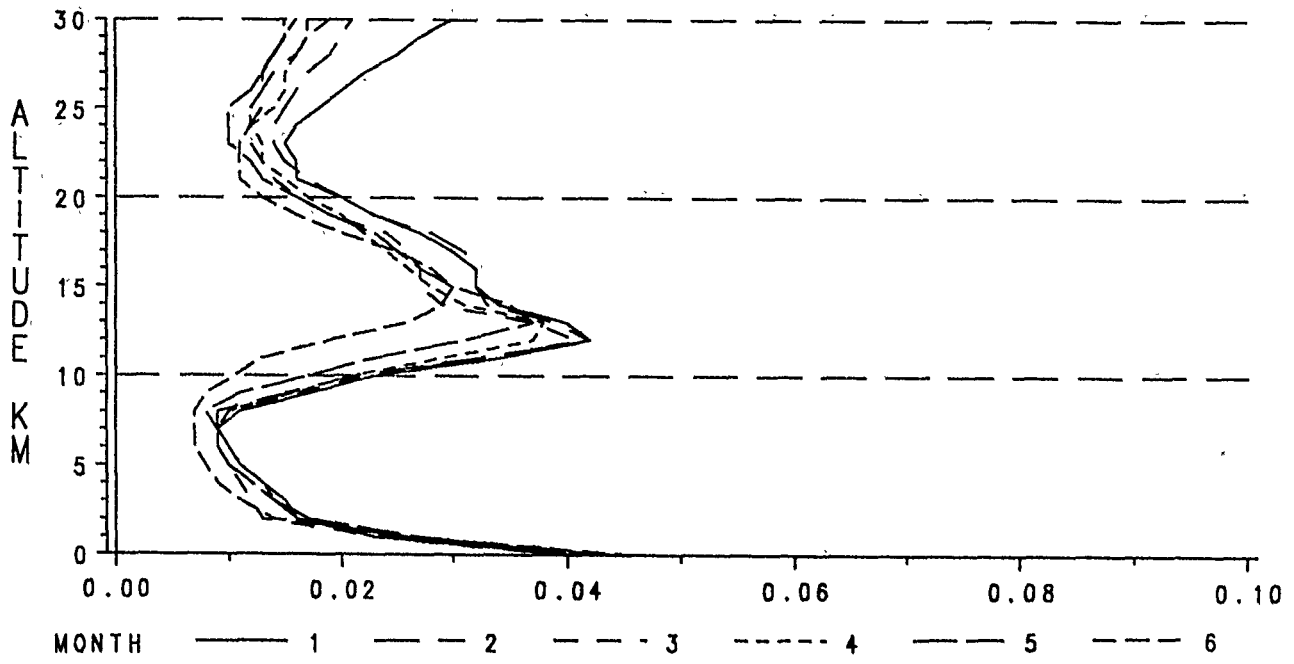


**Figure F-23. Coefficients of Variation for Density, January-June.**

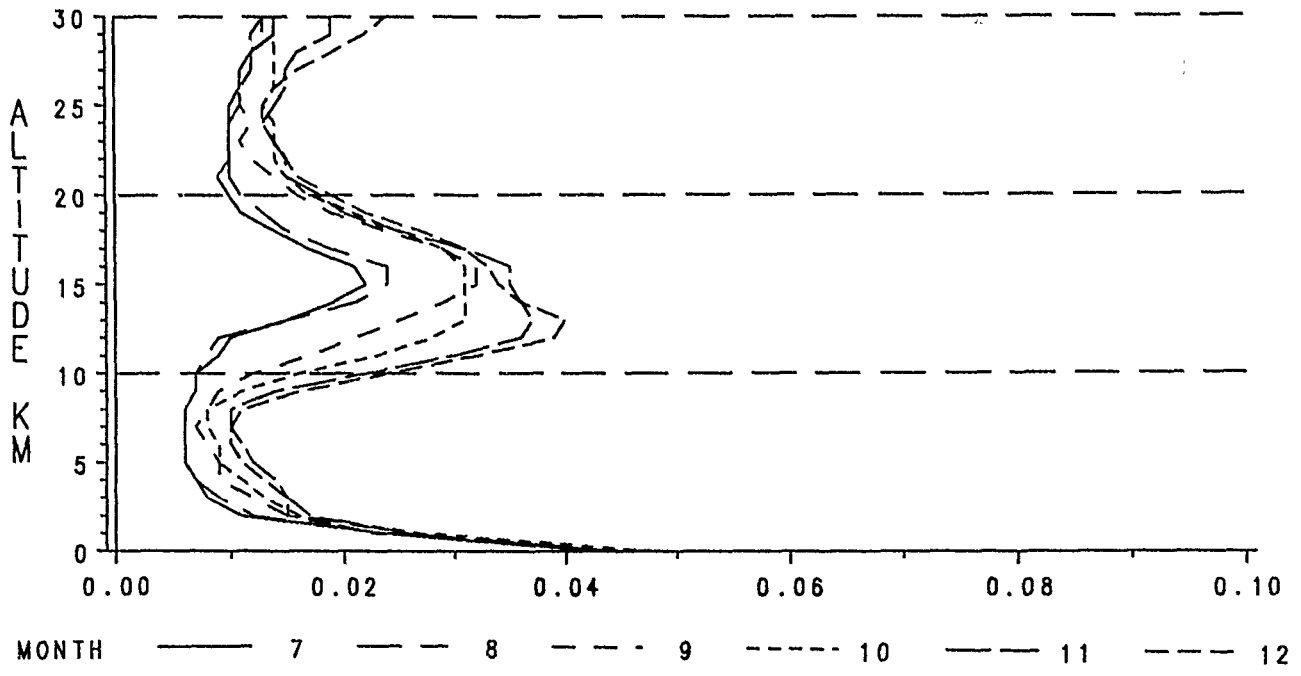


**Figure F-24. Coefficients of Variation for Density, July-December.**

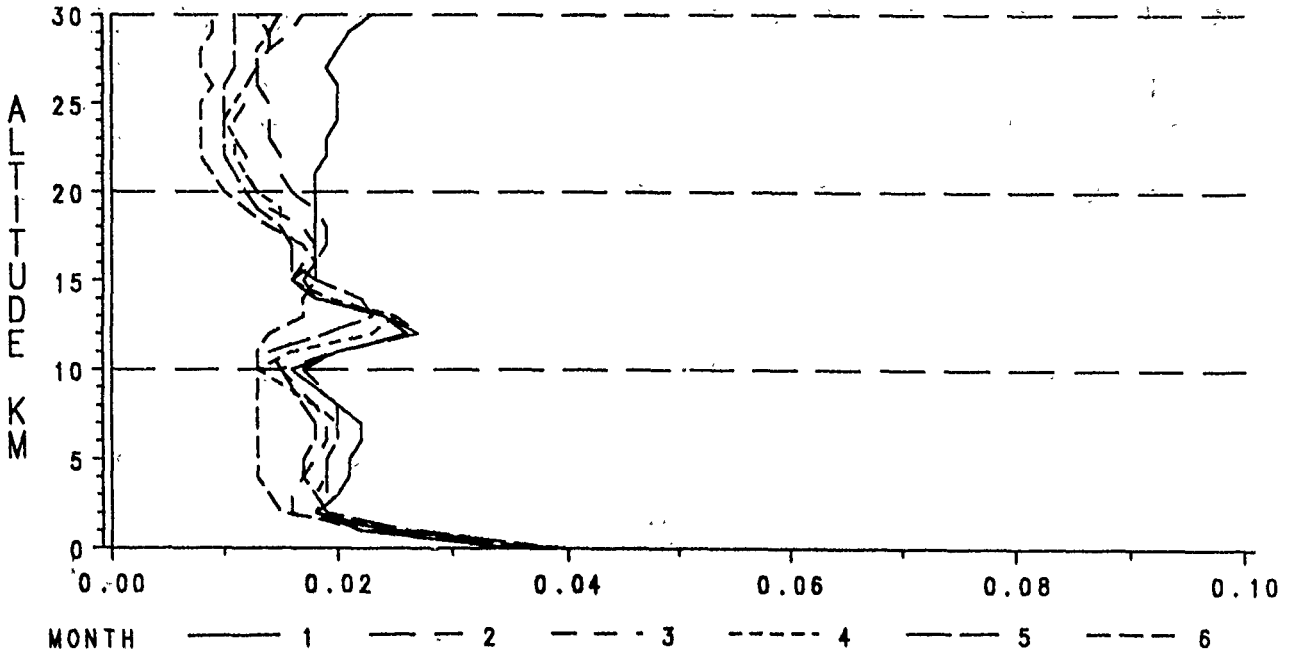


**Figure F-25. Coefficients of Variation for Temperature, January-June.**

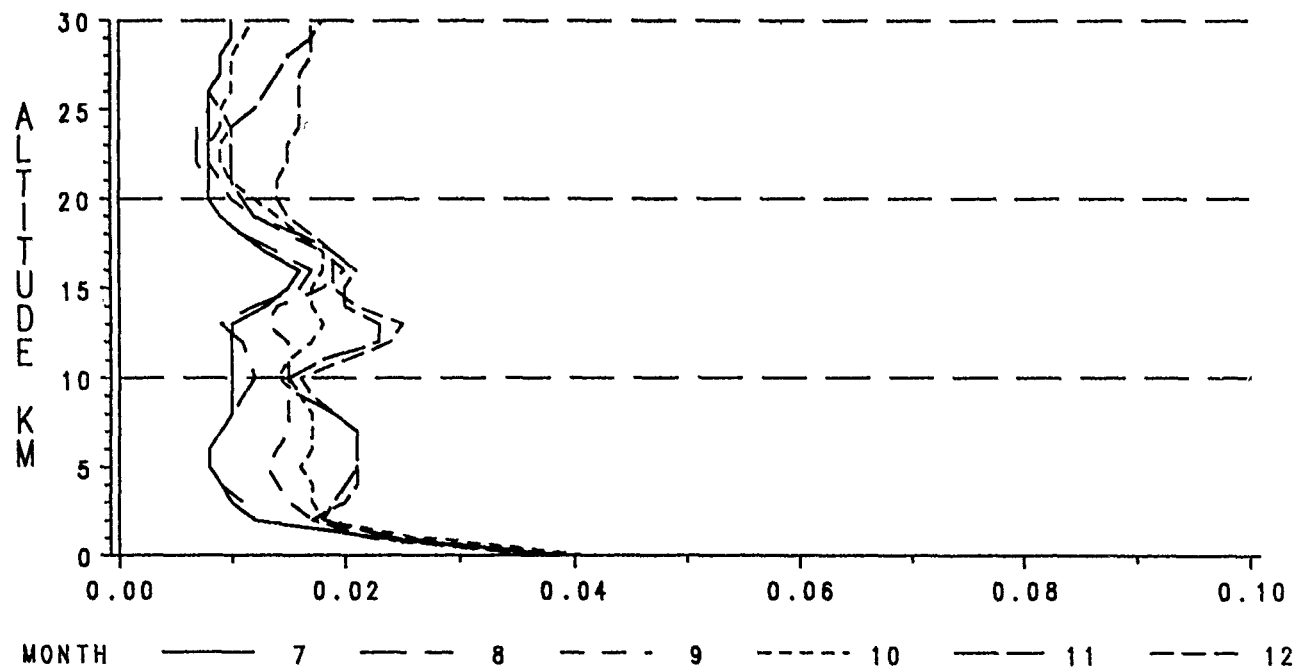


**Figure F-26. Coefficients of Variation for Temperature, July-December.**

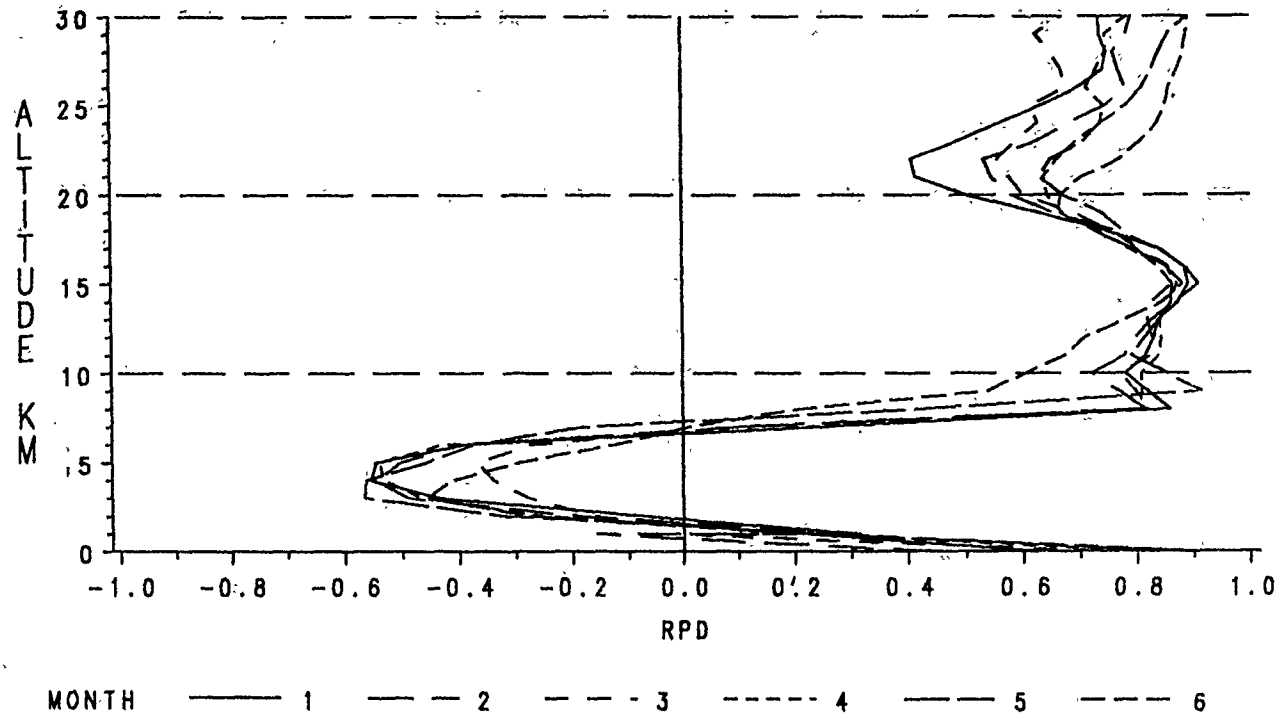


**Figure F-27. Correlation Coefficients for Pressure & Density, January-June.**

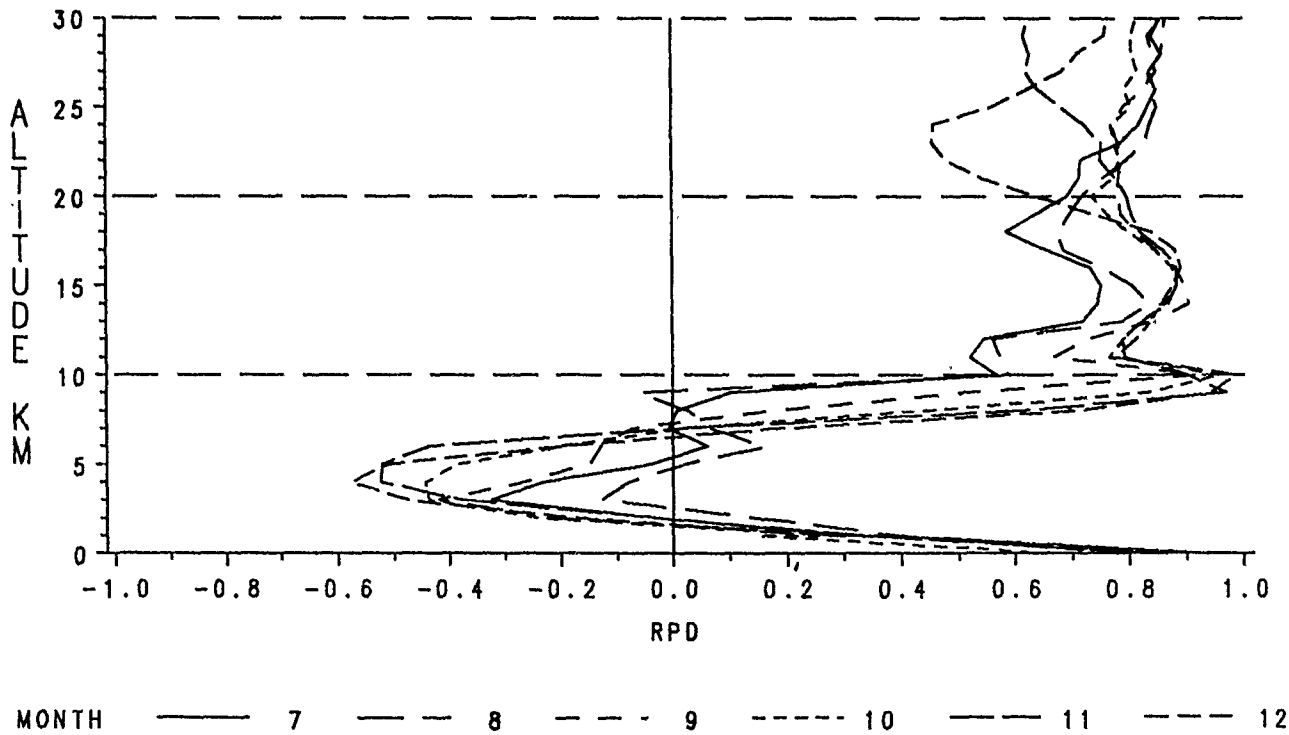


**Figure F-28. Correlation Coefficients for Pressure & Density, July-December.**

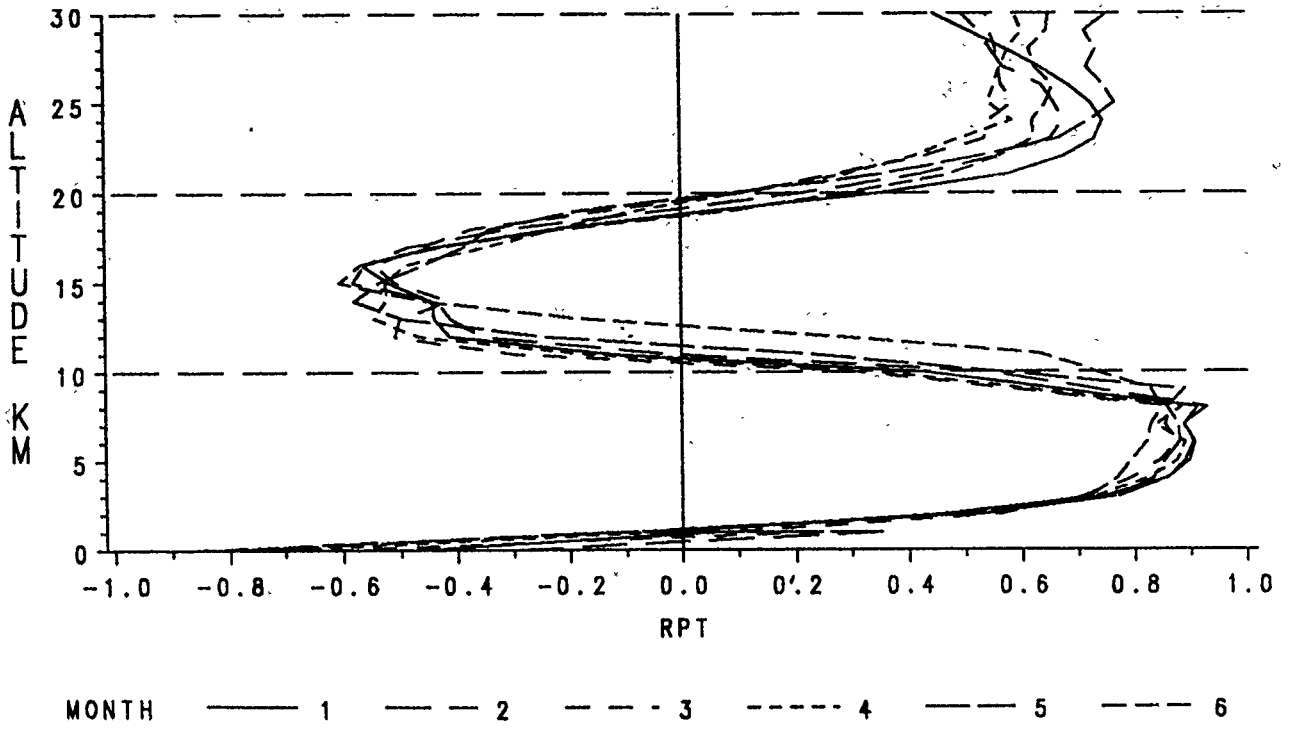


**Figure F-29. Correlation Coefficients for Pressure & Temperature, January-June.**

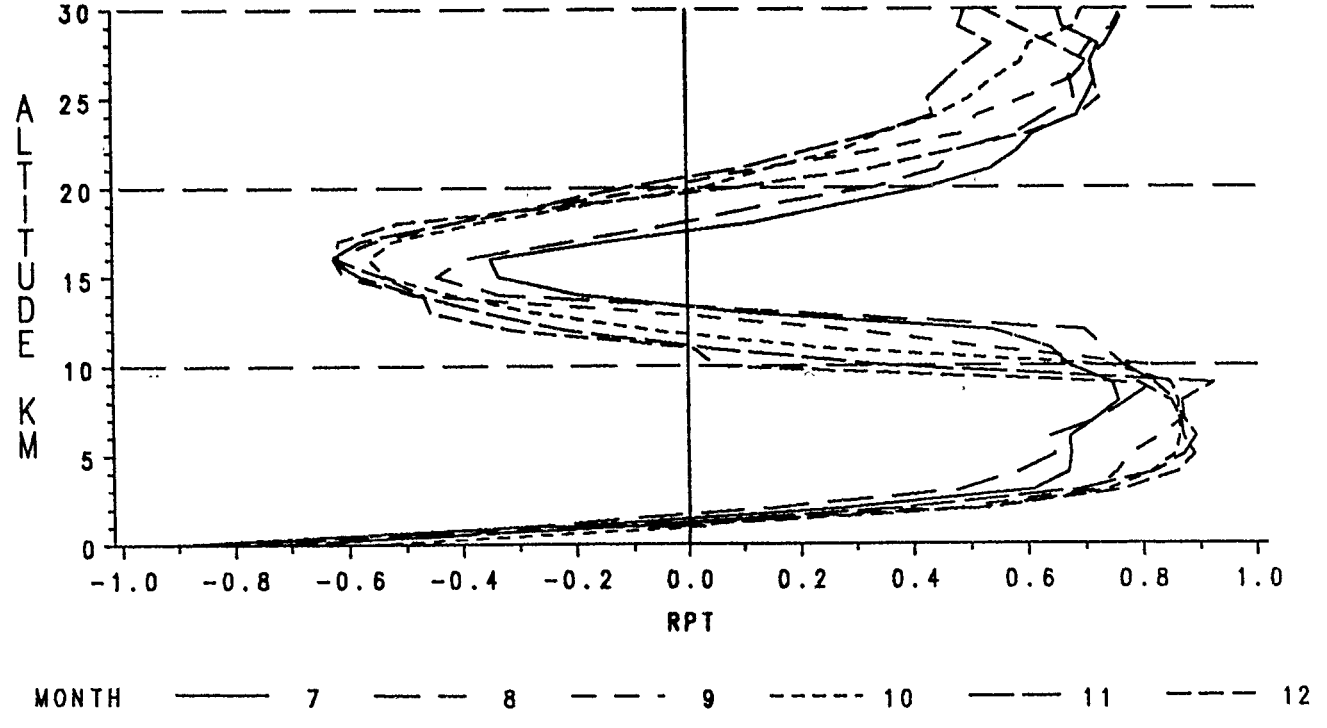


**Figure F-30. Correlation Coefficients for Pressure & Temperature July-December.**

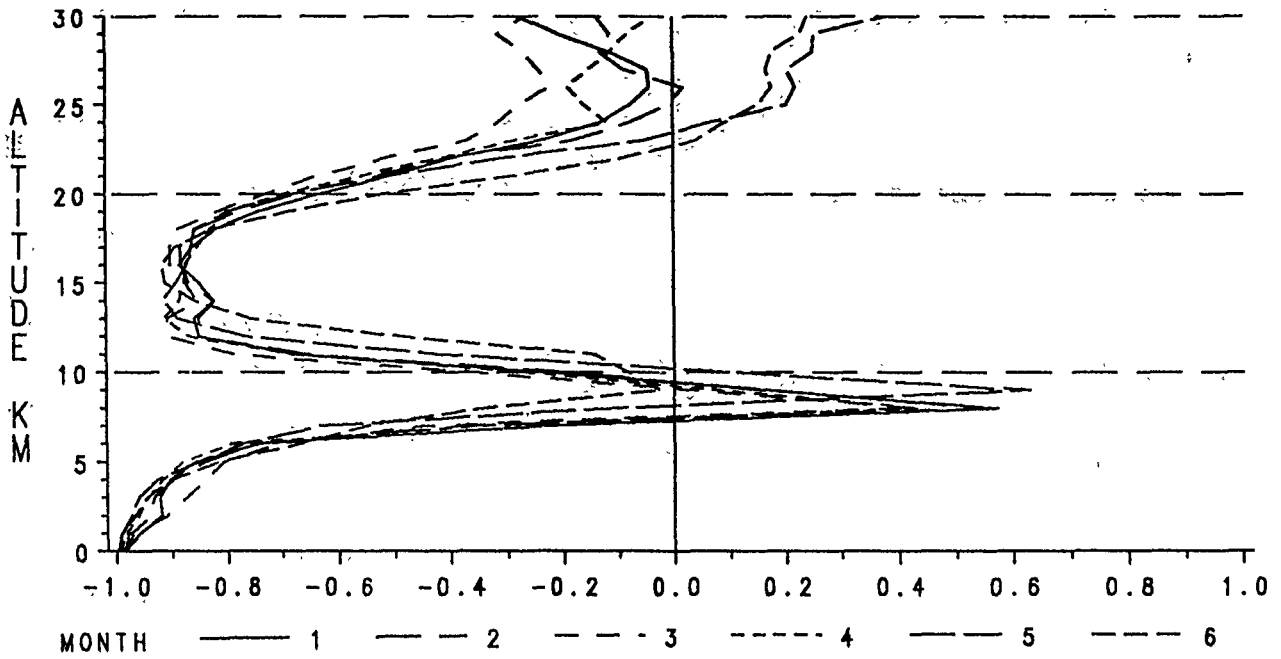


**Figure F-31. Correlation Coefficients for Temperature & Density, January-June.**

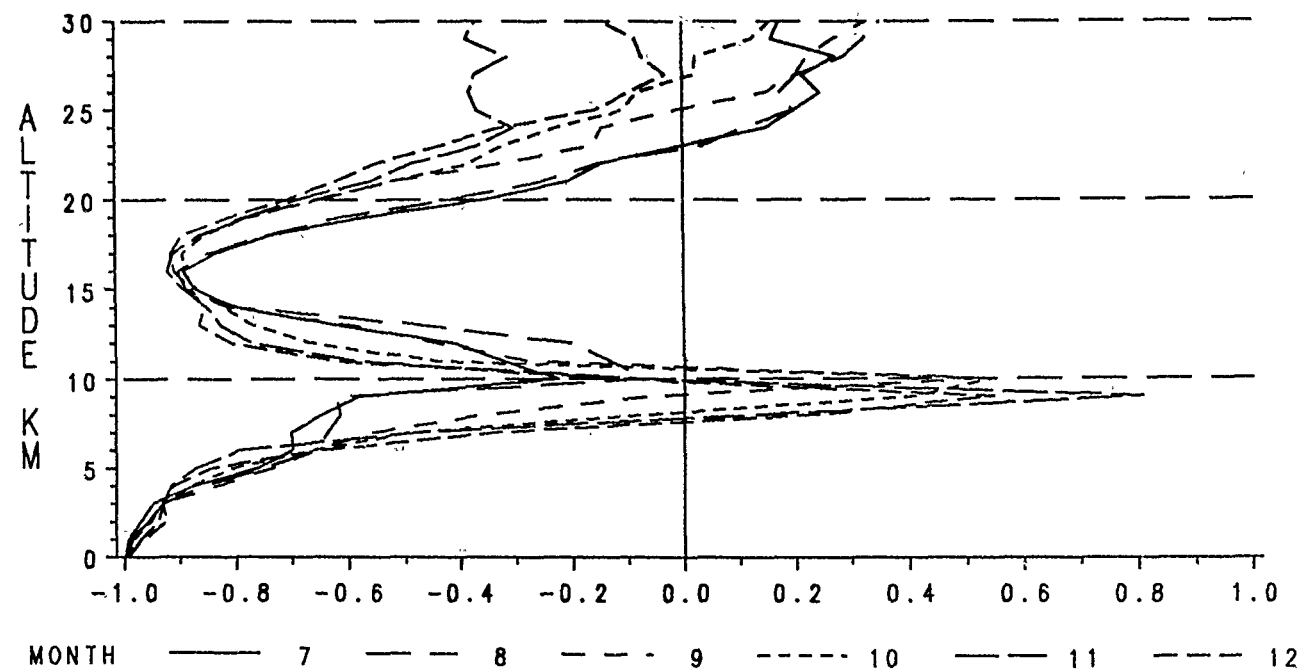


**Figure F-32. Correlation Coefficients for Temperature & Density, July-December.**

## APPENDIX G

### NELLIS (Desert Rock) Descriptive Data

To prevent further character size reduction in the tables given in Appendices A-D, certain range-specific information for Desert Rock has been omitted. The most important information follows:

### Header Record 0-30 km

| | |
|---|---|
| Table Number | 0 |
| Data Source (1=DATSAV, 2=WDC-A) | 1 |
| Call Letters | KDRA |
| WMO Number | 723870 |
| Latitude | 36° 37' |
| Direction (N or S) | N |
| Longitude | 116° 01' |
| Direction (E or W) | W |
| Elevation in Meters | 1,009 |
| Start Period of Record (Mo-Yr) | 678 |
| End Period of Record (Mo-Yr) | 1286 |
| No. of Time Windows (0,1, or 2) | 0 |
| Start Time Window #1 (Hr-Mhz) | 0 |
| End Time Window #1 | 0 |
| Start Time Window #2 | 0 |
| End Time Window #2 | 0 |
| Date of RRA | 1290 |
| Altitude Range of RRA Low-Level (km) | 0 |
| Altitude Range of RRA High-Level (km) | 30 |
| Standard Deviation of Thermodynamics Limits | ±6.0 |
| Wind Limits | ±6.0 |

**The following data is only required for RRAs that go to *70 km*:**

Table Number
Data Source (1=DATSAV, 2=WDC-A)
Call Letters
WMO Number
Latitude
Direction (N or S)
Longitude
Direction (E or W)
Elevation in Meters
Start Period of Record (Mo-Yr)
End Period of Record (Mo-Yr)
No. of Time Windows (0,1, or 2)
Start Time Window #1 (Hr-Mnz)
End Time Window #1
Start Time Window #2
End Time Window #2
Date of RRA
Altitude Range of RRA Low-Level (km)
Altitude Range of RRA High-Level (km)
Standard Deviation of Thermodynamic Limits
Wind Limits